THE TELEGRAPHIC JOURNAL AND

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CONTENTS:

	PAGE
Dangerous Electrical Currents	461
Electric Lighting in the City	462
The Pamphlett-Ferguson Fresh-Water Condenser (*illus.*)	464
A New Electric Tramway at Buda-Pest	465
A Curious Cause of Fault in a Submarine Cable	465
The Automatic Governing of Engines (*illustrated*)	466
Electricity and its Application to Agriculture	466
Testing the Ferranti Cable with a Tension of a Million Volts	467
Induction and other Things (*continued*) (*illustrated*)	467
Storage Batteries at the Paris Exhibition (*Illustrated*)	469
The Westinghouse-Edison Lamp Patent Suit	471
On the Choice of Cables for Alternating Currents (*illus.*)	473
Reviews:—Elementary Manual of Magnetism and Electricity	474
A Dictionary of Electrical Words, Terms and Phrases	474
The Law Relating to Electric Lighting	474
Solutions to the Questions set at the May Examinations of the Science and Art Department	475
Sound, Light and Heat	475
Proposed Electric Lighting at Croydon	475
Overhead Wires and Subways	475
The Electrical and Industrial Exhibition, Birmingham	476
Notes	477
City Notes, &c:—	
Eastern Extension, Australasia and China Telegraph Co.	480
Montevideo Company	480
Contributions to the Chemistry of Storage Batteries.—No. 2	481
The Boston West End Street Railways	482
Electric Lighting in the City	483
New Patents	484
Correspondence:—Teachers and Students	485
Transformer Efficiencies and Coal Bills	486
On Strikes	487
Lighting Public Vehicles	488
Queries	488

DANGEROUS ELECTRICAL CURRENTS.

WHATEVER may have been the motive which inspired Mr. Harold P. Brown to preach his now historical crusade against the dangers of high tension currents, there can be no gainsaying the facts which he has managed to string together in support of his arguments. While he, in America, has done his utmost, either from pure philanthrophy or the love of gain, to bring home to the public a possible danger, Mr. Preece has endeavoured to show us here that risk to life from high tension currents has been much exaggerated; at least, so it has been reported, but we fear that reporting is rapidly becoming a lost art. It is not enough in these days to take down the precise words uttered by a popular lecturer; we must wait until he sees his words in print, and the chances are then that he immediately writes to the Press to the effect that he had been entirely misrepresented, and that what he really did say was something of quite a different nature. But whatever it was which Mr. Preece intended to convey to his hearers, nobody would suggest that his mind was swayed by anything but a benevolent desire to serve and enlighten his fellow men. But this is mere digression. What we wish to bring forcibly before the notice of our readers is the unpleasant fact that the list of deaths from electric lighting, though still incomplete, numbers over 91 in the past few years; yet it must be borne in mind that not one street in a hundred, or one building in a thousand, is at present lighted by electricity, and that more than half the work now done is by continuous currents at low pressure, which cannot well prove fatal. Mr. Brown is right in asserting that it will not do to rely upon the presumption that electric light or power people *must* sufficiently guard the public welfare in order to protect their own business. Nor should we accept as an infallible guide the opinion of the expert who so often believes that he must necessarily fall in with the views of the corporation which engages him, for we have more than once in recent years known gentlemen of high standing give quite opposite reports upon the same matter.

But to return to our object. We doubt whether there is a man in this country engaged in electric lighting who would have credited the statement, if unsupported by hard facts, that the partial list of deaths from shocks amounted to anything like so high a figure as that given. Yet, startling as it is, Mr. Brown asserts that it contains less than one-half the total number of fatal accidents from this cause, for it comprises only the details which he was able to obtain during the past year. He furthermore states that continuous currents were extensively used for the first five years of electric lighting without killing any one, and then, in less than two-thirds of this period, there were done to death nearly 30 persons by the alternating current. It would take up too much of our space to give the particulars of each individual case which Mr. Brown has been at so much pains to compile, so we give only a *resumé* as below:—

Number of deaths from arc light circuits during first five years of use		none.
Number of deaths from arc light circuits during next seven years		64
Of which the pulsating current caused	56	
And the high tension continuous current caused	8	
Of these, grounded circuits caused	42	
While within two years, with less than one-tenth the number of dynamos in use, the alternating current has killed		24
Add deaths by alternating current prior to 1887		3
Total number of deaths in above list		91

Of the 64 killed by arc light currents at least 50 could have been saved by the proper insulation and apparatus. No apparatus could have saved the 27 killed by the alternating current.

Now we do not pretend to say that there exists in this country the chances for fatal accidents which are so frequent in the States, because the *modus operandi* involved in electric lighting differs so entirely in the two cases. But we do wish it to be understood that we have in our midst a lurking danger which has been pooh-poohed in some quarters, but which, nevertheless, we cannot afford to treat in a careless and indifferent

manner, as if it had no existence. It must be remembered that we are only just introducing that particular system which has become a great factor in electric lighting plants in America, and surely we might with advantage take warning by the misfortunes of others.

Such currents as have been proved dangerous should not be tolerated where unintentional death or injury could be caused. The word unintentional is used advisedly, because no one is likely to deliberately throw his life away, and we have yet to see whether such precautions have been taken in this country as will render high-tension currents harmless to both suppliers and consumers of electrical energy. Our only desire is to bring home to those who are engaging in electric light operations that they have already an opposition strong enough from the partisans of other methods of illuminating, and this must not be strengthened by leaving undone those things which they ought to do and thus produce a scare bordering upon panic, which has lately fallen to the lot of New York.

ELECTRIC LIGHTING IN THE CITY.

THE report of the Streets Committee on electric lighting has been referred back for reconsideration. This is not the first time that such a course has been pursued, but the reasons for its adoption on this occasion point to the fact that the members of the committee lack the knowledge which should be at the command in order to properly adjudicate upon the question at issue. Mr. Bridgman is certainly an ornament to the Commission of Sewers, and the City may well be proud of a gentleman who possesses such a profound insight into the principles of economic electric lighting. His reference to batteries is not, on the face of it, very clear, but it is evident that the allusion is to a scheme which was noticed in our "Continental Notes" last week, and which it is desired to introduce here. This looks very like another example of obtaining electrical energy for nothing and netting a handsome profit from the bye-products, and we shall keep a very watchful eye upon the proceedings of the promoters. Another gentleman whose actions do not altogether belie his name, suggests that if arc lamps of 1,000 candle-power are rated at a given charge per annum, why should not the power of the lights be reduced to 500 candles for half the cost and so *ad infinitum*. Really these proceedings of the Commission of Sewers would be laughable if it were not for the fact that life is too short to allow of such dilly-dallying as that which has characterised the action of the Electric Lighting Committee throughout its very onerous duties. The result will be, if we are not very much mistaken, that better gas lights will be provided, for without doubt it is by no means necessary to have a better illumination than, say, double that which now exists. Still, for the sake of private lighting, it is much to be desired that electricity should be decided upon, and we would suggest as a means of enabling the committee to deal more intelligently with the point at issue, that its members should undergo a course of instruction in one of the electric lighting classes at the Finsbury Technical College. Mr. Bridgman at least might then be convinced, against his will, perhaps, that steam engines and dynamos are still as necessary as ever for the production of electrical energy at the lowest possible cost. As matters at present exist the Committee is made the laughing-stock of technical and financial papers generally.

OUR esteemed correspondent, Mr. S. A. Varley, has treated us to a logical (?) argument at the end of his interesting article on "Lightning Conductors" in our last issue, by which he proves that a conductor of no resistance is a conductor of infinite resistance, *i.e.*, is an insulator. After assuming that the same given current is flowing through his conductors as they increase in size, he suddenly makes it mysteriously disappear. We commend the line of argument to those who wish to prove how a man may be his own grandfather. The reasoning is much to the effect that if a drop of, say, acid be diluted with an infinite quantity of water the water will contain no acid. Mr. Varley's arguments generally are also combated in a lengthy letter which has reached us, and which will appear in our next issue.

THE disastrous colliery explosion which occurred last week brings home the necessity of devising some scheme for rendering the workings of mines safe. There is always more or less uncertainty in a colliery explosion as to the cause, as we have generally no means of knowing whether it be the effect of opening a safety lamp or the lighting of a pipe. In the one at Longton it is said that atmospheric changes brought about a dangerous state, and the gas became by some means fired. We consider that by the general adoption of electricity in mines much of the danger would be minimised. The miners' portable lamps, which we have described in previous issues, although somewhat heavy in cost in the first instance, would prove far superior to the so-called safety appliances in use at the present time. This is a matter sufficiently grave for legislation to make the use of the electric light compulsory.

FURTHER convincing details have come to light in connection with the Leeds electric lighting scheme, showing the utter waste of time and money in which the Council has indulged. The question has been under consideration for the past five years, various members of the committee have visited centres of electric lighting, which included a pleasant though costly trip on the Continent, and it was naturally expected upon the return of the searchers after knowledge that some slight information would have been gained of the various systems in use; but such was not the case. We might here remark that if the committee started out on their tour without the first principles of electricity instilled in their minds, they might have stayed at home with equal advantage. However, something must be shown for the great expenditure, and a manifesto was issued which took the form of a review of the history of electric light, which will doubtless be issued in pamphlet form for the benefit of the South Sea Islanders. For a time that was the extent of the work, but lately the Council received an impetus by

the increase of the electric light, and it was resolved to introduce it experimentally in the public reading room of the Free Library. The experiment, as far as the lighting went, was a success, but everyone was amazed at the cost which, for the actual lighting, was enormous. Further sums were voted, and after other highly instructive attempts the Town Hall, the Municipal offices, and the Fine Art Gallery were lighted, the total cost, including luncheons, being a little over £14,000. Thus for the present ends the history of electric lighting in the northern city. It has been a miserable attempt, and we trust private companies will speedily have orders granted them by which they can supply the light to consumers, which we are assured will be numerous. Since penning the foregoing, the Lighting Committee has decided to light by incandescent lamps the Rate Office and also the offices of the police department.

PROF. SILVANUS P. THOMPSON, in a letter to the *Times*, exposes a gross case of jobbery. He received an informal communication from a gentleman of influence with reference to the acceptance of the post of consulting engineer to a certain municipal body which is about to adopt electric lighting, it was also coupled with the suggestion that it was understood the boilers of a certain firm must be used. The reply to such an infamous proposition is worthy the position of Prof. Thompson. We sincerely hope, with the Professor, that the malpractices which have characterised the work of many corporate bodies will not enter into the newer industry of electric lighting. This is doubtless an important factor in considering the advantages of a municipal body or a private concern supplying electricity. Private companies have better safeguards against fraud than governing bodies, and this alone is a decided advantage. There has been so great an amount of fraud in matters municipal, that in some instances we are fearful of the results. The thanks of the electrical world are due to Prof. Thompson for his manly *exposé* of so culpable a piece of jobbery, for we are sure that consulting engineers would feel it acutely if the finger of suspicion were pointed at them as being in league, either directly or indirectly, with the suppliers of material.

CREOSOTING has been universally acknowledged to be an invaluable process for the preservation of timber, and its use is very general in this country. We have not, however, taken to its adoption for underground conduits for telegraphs, a more strongly mechanical protection being usually considered desirable. In the United States, however, the creosoted wood conduit has been largely used in some parts, and whilst in one place its use has been continued and extended, in another place it has been definitely abandoned. A large system of creosoted timber conduit has been in use for some years in Brooklyn, N. Y. Of this it is said, "There can be no doubt as to the durability of creosoted wood. Frequent examinations during the past five years show there is no decay of the wood or change of any kind to cause injury in placing or removing cables. Its economy, flexibility and safety, strongly recommend its use for conduits."

SUCH a strong recommendation would lead one to the belief that creosoted wood was the right thing to use, but it is too well known that there are usually at least two opinions about a thing; Brooklyn is decidedly in favour of creosoted wood, but Boston appears to have a different view of the situation. In a recent article in the *Electrical World* on underground construction work in Boston we find the following: "It has now been practically decided that an absolutely insulated conduit is an impossibility, and as the cables themselves have done their work well, it has been decided to abandon for the future the cheaper work of creosoted wooden conduits, and provide for the cables, which are practically perfect, a thoroughly strong mechanical conduit worthy of them, and which will not rot away in a number of years. The creosoted wood was found also to have a deteriorating effect on the life of the cables." Boston and Brooklyn cannot both be right. Time will show.

THE story told in our other columns by Mr. Peters, of the ss. *Viking*, is the third instance in which whales have broken telegraph cables. The first occurred in the Persian Gulf, some 15 years ago, and the second on the West Coast of America, off the Peruvian Coast, some seven years since. In both cases the whale was dead when brought to the surface by the repairing vessel, and was entangled in the cable. The supposed cause is that the cables were hung in festoons through being laid too tightly over uneven ground, and that the whales used them as rubbing posts to get rid of some of the barnacles with which their bodies are often covered. A swish of the tail can easily account for the cable being twisted round the body, and the weight and the struggles of the animal can easily account for the break. We are inclined to think the weight of the dead decomposing body is more likely to break the suspended bight than the swimming strength of the whale, which, compared to the longitudinal strength of a cable, must be a small matter. The peculiarity of the case off the Brazilian Coast lies in the cable not being broken.

TOUCHING one of our articles in last week's issue, a well-known Professor writes:—"I quite agree with the main statement in Prof. Perry's lecture. He and I are amongst the few who went through a complete training in mechanical engineering *before* taking up electrical work. I advise all our young would-be electrical engineers to go for some years into a good general mechanical engineer's works and learn how engines and boilers are made and worked *before* going into an electrical establishment; but the young fellows think they can take a short-circuit at once." The advice here given is good, and will, we hope, be taken to heart.

THE paper which we print on sparking distances, with high voltages, we commend to the notice of Mr. Ferranti. There are also other articles in the REVIEW which may prove of interest to the advocates of high tension currents.

WE understand that the *Fortschritte der Elektrotechnik* is about to be discontinued owing to unsatisfactory finances. Perhaps these quarterly reports might be made into an annual publication; at all events, we hope that some effort will be made to keep this interesting journal in circulation, for we believe it has been useful to some members of the electrical profession in this country, notwithstanding that it is printed in the German language.

THE PAMPHLETT-FERGUSON FRESH WATER CONDENSER.

THIS condenser is designed for the production of pure fresh water, cooled and filtered for drinking, or hot and unfiltered for making up loss of fresh water to the boilers. The apparatus can be used as a combined evaporator and condenser for producing fresh water from sea water, or from impure water obtained from any source, or it can be used as a simple condenser to produce fresh water from steam evaporated in another boiler.

Perhaps our readers may wonder why a non-electrical apparatus should figure in these columns; an excuse, then, must be that a description of the plant will probably be of great interest to the owners of submarine cable ships, or, indeed, to any electrical men who have to erect plant in foreign climes.

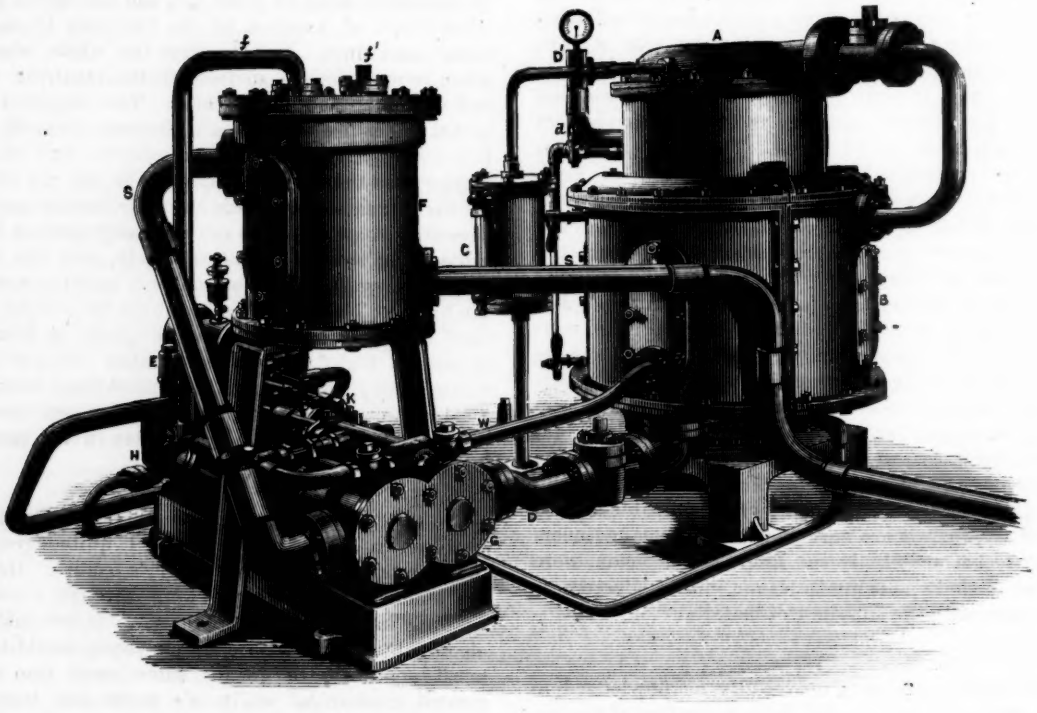
The Pamphlett-Ferguson condenser is the outcome of the experience of an engineer who has had most exceptional opportunities of acquiring a thoroughly practical knowledge of this class of machinery, gained with almost every known apparatus in use for condensing purposes. The object aimed at has been to produce a reliable, simple, easily managed, and easily repaired piece of machinery, that can be tested in detail as to tightness of tubes, &c., and then put together with the confidence that it will produce fresh water without priming, even with high-pressure steam.

It is of little use entering into an elaborate description of the means by which this object has been attained; it will, perhaps, be enough to say that the tubes throughout the apparatus are large, straight and short, and therefore easily cleaned, and that the evaporation is effected under a vacuum, so as to reduce the deposition of solid matter to a minimum, and also to avoid, as much as possible, the offensive odour and taste of water distilled at a high temperature. In every apparatus of this description it is the evaporator which, as a rule, gives the most trouble, the tubes, &c., in it quickly become covered or filled with a solid hard scale even under the most careful management, this deposit being in every case difficult to remove, and involving the disuse of the whole apparatus while the removal is effected.

The evaporator in the Pamphlett-Ferguson condenser is made very small and simple, is easily replaced and inexpensive, so that a spare one can be carried, which may be put in quickly, and the cleaning, &c., of the other effected without hurry or the loss of the services of the condenser. Like the condenser, it can also be tested to make sure of the tightness of the tubes before being put into position, so that, with ordinary care, no loss of time or trouble can arise from leaky tubes. Those who were at Suakim, when condensing was carried on with various sorts of apparatus, may be, perhaps, able to appreciate the absolute value of the special advantage here claimed.

So far as the running and efficiency of the condenser is concerned, a very favourable report has been made by Mr. Maxwell Williams, M.I.M.E., who has practically tested the apparatus, and gives its efficiency as 94 per cent.

The drawing and the following description of the apparatus will make its parts clear. A is a chamber for steam, forming the upper part of the evaporator, the high pressure steam from the boiler being admitted at the bottom; B, a condenser fitted with vertical tubes; C, an automatic feed regulator, supplied by the pipe, *d*,



from the warm circulating water, D', as it leaves the condenser; D, circulating water from the pump entering the bottom of the condenser, B, and emerging warm at D'. E is a steam pump for the following purposes: 1, circulating water pump, G; 2, brine pump, H; 3, condensed (high-pressure) steam pump, K; 4, double-acting pump for forcing the condensed water, W, and air, L, through the cooler, F. F is a cooler and filter combined, the aërated distilled water entering hot at *f* and leaving at the same temperature as the circulating water at *f'*; S, S, suction pipe of circulating water leading through the cooler, F, to the pump, G.

The apparatus is manufactured by Messrs. George Wailes & Co., whose high-class manufactures we can vouch for personally, as we had an opportunity of inspecting several dynamos and other machines in process of manufacture at their works.

The whole of the experiments in connection with the distiller were carried out by Messrs. H. Ferguson and G. H. Wailes, A.M.I.C.E., who have worked at the apparatus for eighteen months; during this period they met with and solved many difficulties in securing such a reliable and perfect apparatus.

A NEW ELECTRIC TRAMWAY AT BUDA-PEST.

[FROM A CORRESPONDENT.]

THE City of Buda-Pest—which, as is already known to the readers of the ELECTRICAL REVIEW, has been for a short time in possession of an electrical tramline which is about to be considerably extended—is soon to be considerably enriched by a quite new electric tram line, interesting on account of the novelty of its construction. This new line is to be laid down by the Buda-Pest Tramway Company which will, in this manner, meet the competition of the Electric City Line, and it has for this purpose already addressed to the City an application for permission to lay down a trial line, utilising the entirely new system which it has acquired. I purpose in future to send you a full description with drawings of this new system. In the mean time I give you the text of the application in which you will find a brief sketch of the essential features and advantages of this interesting system. The application runs :—

The undersigned two firms of this city purpose creating in the territory of the capital a new tram line.

It must be premised that the iron founders and machine makers, Ganz & Co., have at their disposal a totally new construction of tram lines invented by the director of their electric department, Carl Zipernowsky, for which invention they have obtained an exclusive right.

In this construction either horse, steam, or electric power can be used, though it seems that if regard is had to existing circumstances the application of electricity as motive power appears the most suitable.

The advantages of this construction of lines and cars are the following :—

a. The car does not run upon two rails but upon one only, so that the surface of the street is very little interfered with.

b. In consequence the pavement in spared to a great degree, since in alterations and repairs the street is not taken up for more than a metre in breadth.

c. If electric power is used a better and more certain insulation is effected (in consequence of the greater depth of the channel) than is the case in the construction of electric tram lines hitherto known.

d. As the upper bearing rails form a grate-like pipe conduction with the underground rails and sleepers for the whole length of the line, there is secured in the upper structure a degree of stability and elasticity with which no existing arrangement can compete.

e. In consequence of the running rails being arranged side by side within the channel so perfect an adhesion is effected, that with the aid of the brake the car can be brought to a standstill even on inclines in which the arrangements of a mountain railway seem necessary.

f. As the stability of this construction of tram lines does not depend on the durability of an upright rail—the surface is required merely in a single line—it appears possible to use narrower cars, whence it will be possible to introduce such tramways even in the narrowest streets without interfering with the traffic.

We remark further, that a model of this tramway is to be seen in the electric department of the works of Ganz & Co. (II. Hauptstrasse), and we consider it our duty to show it at all times. The undersigned company wishes to place this important invention before the eyes of the world in the capital, Budapest. It has entered into an agreement with the Buda-Pest Tram Company because the separate management of a single line involves great difficulties, and because the tram company are disposed, in the interest of the general public, to organise a joint arrangement of traffic for this new construction on all their lines already in operation.

We turn now to the line of roads along which we wish to create this new tramway. A cheap and certain communication between the outer parts of districts VI. and VII. at the extremity of the Town Wood and its limits and the inner city and the Leopold Town, has hitherto been wanting. It is known that the omnibuses which keep up the traffic do not fairly meet the rightful demands of the public.

Proceeding from this point of view, we purpose employing the new method of construction, which is a Hungarian invention, to lay down a new line, starting from the Town Wood waiting room of the tramway and leading over the Arena Road on the Andrassy Street and Bad Street to the bank of the Danube by the Lloyds' offices up to the point where there is at present the omnibus station. We know that the laying down of a tram line along the Andrassy Road was regarded as not permissible, but we consider that the old objections will be completely removed by this system of a single rail and narrow cars. If a cheap, convenient and safe means of intercourse can be introduced on the Andrassy Road, it will be only practicable according to the plan proposed. But if this plan is rejected from fundamental reasons, we venture to ask for a concession for another route, starting from the same point, and passing along the König Street across the Deák Square and the Deák Street up to the Gisela Square. We venture to emphasise the fact that in the first place, we should wish to build along the Andrassy Street because this line alone fully meets the requirements of the capital. We mention the alternative project for König Street merely because if the Andrassy Street concession is not granted, we must seek another line on which this new construction could be introduced. Either line could be continued through the Marie Valeria Street up to the Revenue Office.

As we thus wish to introduce this native invention in the first place in Buda-Pest, whence it may find its way through the world ; and as this new line stands in connection with all the existing lines of the Buda-Pest Tram Company and hence seems desirable to the general public ; as we further wish to establish one of the two lines above mentioned as quickly as possible, we respectfully request a preliminary concession for six months for one of the above-mentioned lines on the principle of the new arrangement.

A CURIOUS CAUSE OF FAULT IN A SUBMARINE CABLE.

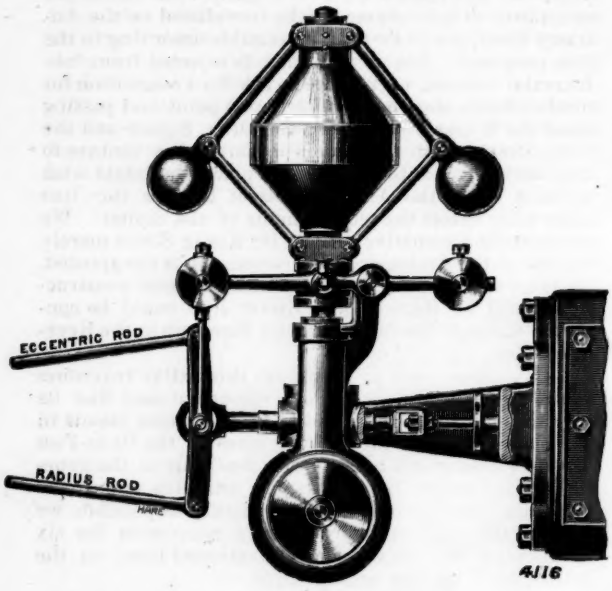
ON September 9th a fault broke out in the Santos-Santa Catharina section of the Western and Brazilian Telegraph Company's system of cables, but through which signals were exchanged up to the moment of cutting by the repairing steamer *Viking*. The latter, whilst engaged on the repair on the 17th inst., picking up towards the fault in 57 fathoms, and about 70 miles north from Sta. Catharina, brought to the surface a monster dead whale, measuring about 50 feet long, intact, with the exception of the upper part (the belly), from which all the skin had been worn or eaten away, leaving only a small portion on the neck and tail ; the cable parted at the fault with the strain put upon it in lifting, and the carcase of the whale being relieved of the downward pressure, rose like a torpedo and inflated like a balloon, a portion on arriving at the surface of the water bursting and creating a most offensive odour, so that everyone was thankful when the cable was cut, and the obnoxious object drifted to leeward ; the tail of the whale had two complete turns round the shank and three or four across the flat or fan part. It would be interesting to know how long this creature had been thus imprisoned ; from the advanced stage of decomposition it must have been there some considerable time ; its body was covered with barnacles, and some even on the white part, where the skin had disappeared.

It is worthy of note that this cable was laid in 1874, and with the exception of one repair by the contractors in 1875, has never since been touched, and is as perfect as the day it was laid.

SS. *Viking*, M. Video, *October 22nd*, 1889.

THE AUTOMATIC GOVERNING OF ENGINES.

THE patent automatic governor expansion gear of Messrs. Ransomes, Sims & Jefferies, Limited, has been recently so much improved that we herewith give an illustration and notice of it. This gear is specially adapted to engines for driving electric light machinery, and in engines fitted with automatic governor expansion gear the setting of the slide valve itself is under the control of the governor. Steam is always admitted to the cylinder at full boiler pressure, and when the load is decreased an earlier cut off is effected.



Thus, in the ordinary throttle valve arrangement, the regulation of the speed of the engine is effected by increasing or decreasing the pressure in relation to the load on the engine, the volume of steam admitted per stroke being always the same, while in the automatic governor expansion gear arrangement the speed is controlled by varying the volume of the steam admitted per stroke, the pressure being under all circumstances the same, viz., full boiler pressure.

The immense advantage obtained by adopting the latter method of governing in engines required for driving machinery which fluctuates very suddenly in the power required, will be readily understood by all who have studied the economy which is secured by using steam expansively.

In this apparatus an independent gridiron expansion valve, working upon the back of the main slide valve, is operated through a knuckle joint by a link, one end of which is actuated by the cut-off excentric, while the other end is held by a radius rod. The travel of the valve and the point at which it cuts off are governed by the position of the link in relation to the knuckle joint, and this position is varied in accordance with the load on the engine by a powerful and sensitive governor to which the link is connected.

By this arrangement the cut-off can be varied between 0 and 70 per cent. of the stroke in proportion to the actual load for the time being on the engine, and the exact amount of steam necessary to do the work required being admitted at full boiler pressure up to the point of the cut-off, the entire benefit of the principle of expansion is obtained, and, in cases where an engine is required to work under varying loads, a very considerable saving in the fuel consumed is effected.

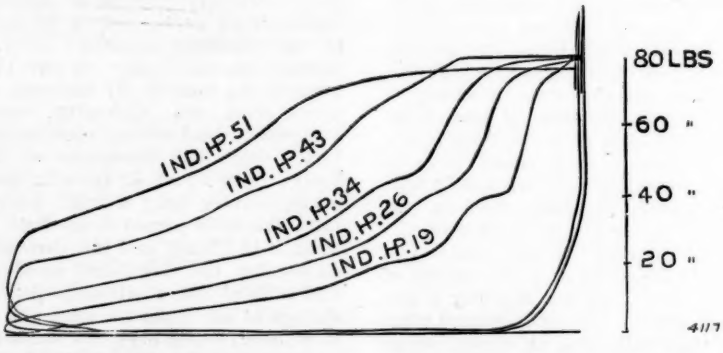
The value of the wide range in cut-off obtained will be appreciated when it is stated that if the cut-off is effected at 70 per cent. of the stroke, the horse-power given off by the engine will be equivalent to about four times its nominal horse-power.

In addition to the advantage arising from the economy effected in the fuel consumption by the adoption of this gear, the speed of the engine is maintained practically constant under the greatest possible differences of load, the variation in the number of revolutions in no case exceeding about 2 per cent.

ELECTRICITY AND ITS APPLICATION TO AGRICULTURE.

A CONSULAR note has just been published showing the initiative taken in the application of electricity to agriculture in Belgium. MM. Dumont, two farmers at Chassart, have for some time been performing some interesting experiments as to the transmission of power by electricity in a direct manner, that is to say, without the intermediary of accumulators. These are, it appears, the first undertaken in Belgium, and they merit the more attention that they are undertaken in agriculture, which is generally regarded as the least progressive of all industries. The following is, according to M. Arène, Vice-Consul at Mons, the last experiment undertaken by MM. Dumont:—

A Ransome threshing machine was working in the midst of stacks of wheat without the aid of an engine. There was neither fire nor steam. The sheaves went into the thresher to come out at one end in the form of straw, at the other in the shape of corn, where it was received in sacks and was ready for market.



Ten horse-power was furnished by a small dynamo-electric machine placed quite close to the threshing machine. The rotatory shaft transmitted its high speed to the shaft of the thresher by means of an ordinary endless leather strap. The electricity which worked this dynamo was conducted by a copper wire 6 millimetres in diameter, covered with a layer of insulating material and running on posts. The source of the electricity, which was 800 metres distant, consisted of another dynamo installed in the vast works of Chassart, which include a sugar factory, a distillery, and repairing shops, occupying an area of 10 hectares. Here was found a dynamo worked by a powerful horizontal

engine of the Hoyois system. This dynamo received 16 horse-power.

The work of this steam engine was transformed in the first place by the first dynamo into electricity which the metallic wire transmits to the second dynamo situated near the thresher, where an inverse transformation is in operation; the electricity there leads to a reappearance of the mechanical power, which passes lastly, through the strap, to the shaft of the thresher. These two transformations of mechanical labour into electricity, as well as the resistance offered by the metallic wire to the passage of the electricity absorb a sensible portion of the total labour. The steam engine furnished 16 horse-power, while the threshing machine received but 10, from which there was a yield of about 60 per cent. Such is, in substance, M. Arène's note, and those interested cannot be too strongly invited to follow these experiments, which are so full of promise to those engaged in agriculture, both from their economical advantages and from their security compared to the motors usually employed in farm work.

TESTING THE FERRANTI CABLE WITH A TENSION OF A MILLION VOLTS.

By Dr. A. KOEPSAL.

THE experiments of Ferranti on cables for high tension, as reported in various journals and quoted in some German papers, induce me to make some remarks which, I hope, will serve to place these experiments in the proper light.

It is maintained that M. Ferranti has made experiments with tensions up to one million volts.

Probably none of the writers and reporters has clearly comprehended what that means.

We must, in the first place, ask how M. Ferranti has measured these tensions?

There is no actual measuring apparatus for this purpose, and it can hence only be conjectured that this tension has been estimated from the length of the sparks and has been seriously over-valued.

It is known that the length of the sparks does not increase in proportion to the potential difference. The experiments of Sir W. Thomson (Reprint of papers) on the appearance of a spark between two plates, show distinctly that there can be no idea of proportionality between spark length and potential difference.

Macfarlane, who operated with sparks of 0·1 to 1 cm. in length, found that the results could be represented by the formula:

$$v = 66{\cdot}940 \cdot \sqrt{x^2 + 0{\cdot}205\,x},$$

in which v is the potential difference and x the spark length, in other words, by a hyperbola; if the sparks strike between a ball and a plate, or two plates, the curve approaches a parabola.

Mascart (*Traitè d'Electricitè Statique*) operated with spark lengths of from 0·1 to 15 cm. With two balls of 22 cm. diameter, he found—

Distance.				Potential difference.
0·1 cm.	...	...	...	5,490 v.
0·5 „	...	...	...	26,730 „
1 „	...	...	...	48,600 „
1·5 „	...	...	...	57,000 „
2 „	...	...	...	64,800 „
5 „	...	...	...	94,800 „
10 „	...	...	...	119,100 „
12 „	...	...	...	124,200 „
15 „	...	...	...	127,800 „

Lastly, Warren de la Rue and H. Müller also have made similar experiments. According to them, the spark length between a point and a plate increases approximately as the square of the potential difference for distances up to 1 cm.; at this distance the potential difference is 9,200 v. If the length exceeds 2 cm., the potential difference increases very slowly, so that it does not go beyond a certain limit, which falls about 120,000 v. This applies to a point and a plate as electrodes; but it appears from the researches of Mascart, that for two balls the limit lies rather higher, though it can never rise to a million volts.

Even if we assume that after 15 cm. the spark length would be approximately proportional to the square of the potential difference, following a simple parabola,

$$v^2 = 2\,p\,x,$$

it would follow from Mascart's experiments that to a potential difference of one million volts, there would correspond a spark length of 9 metres! In reality, however, this would be considerably greater, since in applying the above formula to Mascart's observations, $2\,p$ becomes constantly smaller and smaller, and v therefore seems to approach an upper limit, not easily determinable, but not lying above 200,000 volts; this limit of tension would require a spark considerably longer than 9 metres.

It is not conceivable that anyone with earthly resources can produce sparks of 9 metres in length, and the million volts of M. Ferranti may thus be dismissed to the realm of fable.—*Elektrotechnische Zeitschrift.*

INDUCTION AND OTHER THINGS.

(*Concluded from page* 445.)

THE most courageous student, if not disheartened by the last part of the first chapter of Maxwell's hornbook, is generally thoroughly saddened before he comes to the electro-magnetic theory of light. In order to make his equations perfectly general, Maxwell assumes his coordinates, surfaces, forces, &c., to be all slanting, so that the reader frequently has to keep a whole collection of components and direction cosines in his head. Most people prefer to arrange things so as to avoid these as much as they can, and, where possible, to confine the discussion to a plane. They feel that if they can clearly see what is meant in a plane case, they may take it for granted that it comes right in three dimensions. Many problems cannot be treated in two dimensions; and the electro-magnetic theory of light is one of them. Probably there is no one so well able to put such a matter clearly as Dr. Fleming. His last chapter, on the "Dynamical Theory of Current Induction," is the best in the book, and saying that is paying it no small compliment. To explain Maxwell's theory of light Dr. Fleming takes a conductor with a current started instantaneously in it, and takes the axes to agree with the direction of the current. The induction would, so to speak, spread out instantaneously if there were nothing to prevent it; but whenever it tries to increase at a point it causes a displacement current, and the displacement current causes opposing induction; in fact, like an induced current, it demagnetises. The displacement current depends on K, so that the greater K is, the greater the opposition, and the demagnetising effect of a given displacement current depends on μ, so that the greater K and μ are, the slower the disturbance travels.

Of course, in this part of the book we naturally get into the world of speculation as to the ultimate nature of things. There is a great tendency in discussing these matters to confuse a hypothesis, which to some extent works, but is still a hypothesis, with a statement of fact. Dr. Fleming is, however, generally pretty guarded in his statements, and is not so apt as, say, Dr. Lodge to waltz into the unknowable in seven league boots. The ultimate constitution of matter, and all the kindred subjects, can never come within human experience until we meet the great Teacher, Death, and is therefore not within our mental grasp. It is inconceivable, and all attempts to reason as to the nature or even the existence of luminiferous ether, molecules, atoms, and so on, are only futile endeavours to penetrate into the Unknowable. The term theory is used in more than one sense. In the form of theorem it is used to denote a deduction of mathematical certainty, as Fourier's theorem. It is also used to denote investigations depending on known

laws, as the theory of bridges. It is most generally used to denote a more or less elaborate hypothesis, but the meanings are often confused. Thus the prediction from the theory of heat that compression would make ice melt, or the prediction of the Thomson effect is not at all the same process as the predictions founded on the undulatory theory of light. The atomic theory is sometimes regarded as a mere speculation; sometimes as a known fact. That is to say, the word originally used, in one sense, unconsciously suggests another.

Writers on logic do not, as a rule, point out clearly the difference between induction which leads to a generalisation within experience, and induction which leads to one which is unthinkable. All knowledge may be said to depend on the former or the ordinary process of induction; but no knowledge has ever been acquired by the latter. It must, of course, be noted that a generalisation which asserts that because a working hypothesis fits all known cases it will probably fit a new one is really a form of ordinary induction, as the assertion is thinkable. But when, for instance, it is said that because all actions of which we have experience are actions through contact, and not actions at a distance, gravitation acts through a medium, the induction would be illegitimate, even if the premiss, that we only have experience of actions through contact were true. The two meanings of the term "inconceivable" must also be kept in mind. A round square, or black white, is inconceivable only in the sense that it is a contradiction of terms—it is nonsense; matter that is infinitely divisible, or atoms that are indivisible, are both inconceivable, because neither they, nor anything analogous to them, can come within the experience of man. In these cases conceivability or inconceivability can be no test of fact. In such discussions as we are now concerned the argument from conceivability is frequently used; but it is valueless, it can always be used with equal force on the opposite side.

We can never know more of the ultimate constitution of matter than a man blind from his birth can know what vision is. The blind man might, in fact, know something through hereditary instinct. A curious case of a blind man has occurred. In a life of Haydn, written under the *nom de plume* of "Bombet," we think it is, there is given an account of a blind man's idea of colours. Red was like the sound of a trumpet, and blue like that of a flute, and so on, and things like coloured eggs are shown to represent the notes of the scale, pitch being represented by size. It never seems to have occurred to anyone that the blind man was merely talking nonsense. To this day musical literature is saturated with ideas rising from a false analogy between sound and light, and if this was the origin or the confirmation of the absurdity, it depends on a man's trying to describe what was inconceivable to him. Pope's superior beings, who amuse themselves with Newton, may regard our ideas of atoms as we do the blind man's ideas of vision. A perusal of many of the books on physics would lead anyone to suppose we knew there were such things as molecules, atoms, ether, and so on. We may safely leave these matters, however, in the infinitely abler hands of Mr. Stallo.

We have been thoroughly roused by Prof. Flower's British Association address, and we are going to start a museum in Paternoster Row. It is to be a museum of a new kind, and its space is to be filled with the various atoms and molecules brought into use by different speculators. Some American writer, Hawthorne, perhaps, wrote about a museum of mythical objects. Our objects are not going to be merely mythical; we will admit nothing that is not inconceivable. Though the exhibits will be small, the enormous number of varieties will demand considerable room, and we may have to extend into St. Paul's Churchyard. We will have cases containing all the ordinary or common atoms. Globular atoms which are perfectly hard, globular atoms which are infinitely elastic, globular atoms which are all the same size, and which are all different sizes. Atoms and molecules which attract and repel one another, according to all sorts of powers of the distances between them; Biscovitch atoms, which have forces acting on immaterial centres, and so on. Then there will be a gallery for chemical specimens, with a complete collection of such things as benzene molecules, and various atoms with bonds, the average specimen being between a burr and an octopus. A special gallery will be set apart for kinetic gas atoms. The visitor will be slipped in by Maxwell's demon, who will open the door when no dangerous atom is coming in that direction. On payment of a small extra fee, the demon will perform tricks with the atoms. For instance, he will place four mirrors in the corners of the room, and will charge all the atoms electrically. By means of a hand mirror he will make some of them go round the room in the same direction, reflected by the stationary mirrors. By dexterous use of his hand mirror he will make the rest of the atoms impart their energy to the stream going round the room, and will put them aside in a rack. The velocity of the moving stream will now be greater than that of light, and the atoms will attract one another and form a stream of liquid—or, perhaps, of solid matter—flying round the room. The section most interesting to our readers will be the electric department. There will be electrolyte molecules in which the atoms or radicals are electrostatically charged. Electro-chemical atoms charged so highly, positive and negative that they cannot be made to exist alone; and atoms of free elements which somehow combine into molecules in spite of the similar charges on them. Then there will be molecular vortices of all kinds, active wheels and so-called idle wheels. The last owe a debt of gratitude to Dr. Lodge. The other wheels used to revile them and call them capitalists. There will be specimens of diamagnetism atoms with perfectly conducting stripes, like croquet balls; and paramagnetism atoms. These are made in Ireland. You take some induction and wrap some perfect conductor round it. Then there will be Macaulay dia- and para- magnetic atoms. They are charged statically, but are not conducting. A diamagnetic atom is still till a magnetic force is applied, and this force rotates it and then alters its axis of rotation. The paramagnetic atoms are in a normal state of rotation, but their axes are in all directions before the material is magnetised.

As many of the properties of matter are also ascribed to ether, we will have a storey for various ethers. The exhibit that will attract most attention will be Young's solid steel like ether and Herschel's modification under a pressure of seventeen billion pounds on the inch. As it is inconceivable that such ether can exist without something to hold it, and as inconceivability is generally taken as a proof of non-existence, we will show a model of the firmament. The ancients used to think the firmament was a hard blue thing with stars stuck in like bright headed nails. It is nothing of the sort. It is a sort of boiler, carefully caulked ether-tight and tested to 17 billion pounds per square inch. Some day it will burst, and the ether and stars will fly out like the inside of a squashed gooseberry. We will also have numerous specimens of more modern kinds of gelatinous ether. There will also be a biological section. As everything in an animal depends not only on the circumstances in which he is placed, but upon the embryo cell from which he is developed, it is obvious that in the original cell was wrapped up all the innumerable qualities in every individual which ever was or ever will be. Cells contain smaller cells, and so on; and on careful examination of a primeval cell we may notice the particular peculiarity which would have produced the particular kink—or brain scar, we believe, is the technical term—which would have made Macaulay write this particular review in this particular way, had he been alive now. We hope to obtain for this section the original amœba, or whatever it is; we mean the Primordial Atomic Globule himself. Comtists will be admitted for purposes of worship at a reduced price, as this exhibit contains the whole object of their religion wrapped up like the skins of an onion.

Dr. Fleming devotes the last section of his book to the discussion of Prof. Poynting's papers. He does not point out clearly, as Prof. Poynting does to some

extent, that the whole argument assumes that energy is in some ways a kind of matter. It has a locus for instance. If it disappears at one place and appears at another it must have crossed the intervening space, and so on. There is a tendency, due to the limitation of human experience, to picture things as matter. In old days energy would have been a young person artistically draped in a sheet. The old days of anthropomorphism have nearly gone, and what our Greek editor would, perhaps, call hylomorphism has taken its place. For instance, there has always been a tendency to treat such things as light and heat as matter; and even now, if we want to give an elementary explanation of electrical phenomna we talk of electricity as fluid. Energy is now becoming a sort of matter. It exists in a place, and moves continuously to get anywhere else. We shall certainly add some energy to our museum. We will have a joule in a little work-tight bottle, carefully stoppered, to see that there is no leakage of power, like fumes from a bromine bottle. The question of velocity of energy revives the old question as to where the energy is when a brick has been lifted on to the top of a wall. It has been said that it is not in the brick, for that there should be anything in a still brick which could have time as a dimension is inconceivable. An argument from dimensions and inconceivability together proves conclusively that the energy is stored in the medium. Similarly, the question as to transmission of power that puzzles engineers is raised. The idea that energy goes along a belt at the velocity of the belt is untenable, of course. Then how does the energy get along a rotating shaft? No doubt at the velocity of sound in steel or iron, as the case may be. Similarly, it goes along a belt at the velocity of sound in leather.

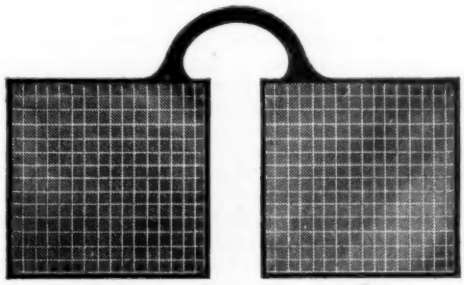
Various opinions are held as to what a review should be. Some say it should show the author how his book ought to have been written. This is wrong, for the average author knows more of his subject than his critic does. Besides, the book is already written. Others state it should say what the book contains, so that a reader of the review may know whether he wants the book. On that ground we should merely publish the contents. A reviewer is sometimes supposed to correct small slips and misprints. We are not proof readers, but what few we have noticed we will point out to the publishers privately for correction in the second edition. If a reviewer is supposed to say whether a book is worth buying, Dr. Fleming's book only costs 26 stiveroons, and contains an enormous amount of valuable matter which can only be got otherwise after laboriously hunting it up in back numbers of various journals, and cannot be got anywhere else in the plain and concise way it is given by Dr. Fleming. Being a science book, it is, according to Lamb, one of those books which should be on the shelves of every gentleman's library, and stay there. We certainly think every electrician should have it, and only leave it on his shelves occasionally. Dr. Fleming always writes with an absolutely clear head, and realises what a student's difficulties may be in grasping a subject. There is a great want of a book on physical or practical mathematics, which omits all discussions of purely mathematical interest, and gives just what is required for application in physics and engineering. Such a book should be designed for self-instruction, and should not be written with the idea that mathematics is, like virtue, its own reward, or that the great object of its study is to pass an examination or get a degree, or to write hypothetical investigations on inaccurate data. If we might make a humble suggestion, it would be that Dr. Fleming should write such a book. No one could do it better. Whatever else a review ought to be, it should be short and to the point.

Electric Regulating Clock Company.—We hear a company is about to be formed in Berlin for the regulating of clocks for private houses through the telephone wires, by an automatic "minute transmitter."

STORAGE BATTERIES AT THE PARIS EXHIBITION.

By A. and F. RECKENZAUN.

GENERALLY speaking, electrical engineers have been more or less disappointed with the electrical exhibits at the great Parisian show. There is little in the way of novelty, and nothing that would strike one as magnificent. Any layman not acquainted with the importance of small details would have to be pardoned were he to contrast the present display of electrical machinery with that of the electrical exhibition of 1881, and say that he cannot discern much progress after a lapse of eight years. Yet we know it as a fact that few industries, if any, have made such strides as electrical engineering within so short a space of time. But the layman had to find this out by reading tabulated statistics which are hung around the screens, rather than by actual demonstration. Of course, one could not expect to find a duplicate of the Deptford central station placed within the precincts of the Champs de Mars, but no approach to grandeur was made, and even the wonderful Eiffel tower was illuminated with thousands of gas jets in lieu of electric lamps. If quantity were a measure of progress, the present display of storage batteries at the exhibition was far behind that of the ill-fated Société de la Force et la Lumière of 1881. This year, however, gave us better quality and greater variety. None of the English or American manufacturers of storage batteries are directly represented. The Electrical Power Storage Company, the largest concern of its kind in the world, held aloof, and let their licensees, la Société Française d'Accumulateurs Electriques, make a modest demonstration of the existing state of the art. Curiously enough the French company have adopted Mr. J. S. Sellon's new design of twin plates, which the parent company in London, and its offspring in New York, have not had the courage to initiate. This innovation is illustrated in figs. 1 and 2;



NEGATIVE. POSITIVE.

FIG. 1.

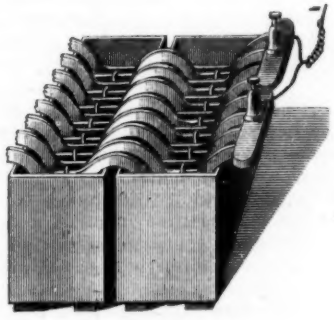


FIG. 2.

For convenience in casting and pasting, the grids are cast separately, each with its half of the lug, and these are subsequently burned together to form the whole. This company also exhibits historical samples of the Faure accumulator, which has never been found to answer in practice, yet the jury awarded the gold medal to M. Faure personally, and to his licensees, manufacturers, exhibitors—in short, the people who made something that would work, the silver medal.

M. Gaston Planté, unfortunately, did not live to receive the Grand Prix which was awarded for his exhibits, and which are of great historical interest. A considerable portion of the apparatus invented by Planté, and described in his famous work, "Récherches sur l'Electricité," partially covered with crape as a sign of mourning, can there be seen.

The Société l'Electrique, of Brussels, have a fine show of cells, principally traction cells, as used in the Julien cars at Brussels and New York. This company also exhibits a battery which has been considered novel by those who are not aware that the E.P.S. Company have six years ago constructed a quantity of similar things which were found to be a failure. This battery consists of a series of hollow cones of lead, or an alloy of lead, pasted inside and out in such a manner that the inner surfaces represent the negative and the outer surface the positive electrode. These cones are placed one inside the other, insulated, and the spaces between them are filled with diluted sulphuric acid. A column of, say, ten such cones, would give an E.M.F. of about 18 volts. It is claimed that this battery is suitable for tramway work, but this will be doubted by most men who see it, and know the conditions of such a service.

We had to search very diligently in order to discover in nooks and corners samples of various kinds of secondary batteries. The Oerlikon Works, for instance, who exhibit a quantity of electrical and other machinery, were contented to place some of Dr. Schoop's cells in an out-of-the-way place, where anyone, not knowing of their new speciality, would not have looked for it. The plates of these cells are of the pasted type, made of grids, with triangular holes; the paste, it is said, is much more porous than that of the E.P.S. Company; in fact, it is claimed by the inventor that the weight of the active material for similar capacity is only two-thirds of that generally used in pasted types. But the most important part of this accumulator is the solid or semi-solid electrolyte, which is made of inorganic substances, and which is not attacked by sulphuric acid nor by the current. Through the courtesy of Messrs. Johnson and Phillips, of Charlton, we have had opportunities of testing a large cell filled with Dr. Schoop's electrolyte, and found that when discharging (practically short-circuiting) this cell at the rate of 300 ampères the E.M.F. kept constant for about half an hour at 1·8 volt. This would show that the internal resistance is but little affected by the use of a gelatinous electrolyte which offers several advantages and costs only a trifle more than acid. The method of connecting the plates centrally, and at the four corners, is not quite as novel as it is practical.

The battery of M. Reynier, with its "plaited" lead electrodes, is sufficiently well known, from descriptions in books, to deserve special mention, excepting that it obtained a silver medal. Another silver medal was awarded to M. Gadot, who makes lead plates of double grids, riveted together in such a manner that the square holes offer concave surfaces of support for the paste. Mr. J. S. Sellon will doubtless be able to tell whether this is *novel*.

M. Simmen exhibits plates made of lead wool of remarkably fine texture. This wool, or extremely fine lead wire, is pressed into perforated plates or rectangular lead frames, and offers a very large active surface. One kilogram of these plates, when well formed, has a capacity of 7·3 ampère hours. We know nothing of the durability, and this is the question which is oftenest asked but so seldom satisfactorily answered.

The accumulator of M. Garassino, of Turin, deserves attention. The plates are made of ribbed castings, not each positive plate is permanently connected to the negative of the next cell, by having one lug in common. perforated as it would appear from the sketches, figs. 3 and 4. The ribs are on both sides of the plate, with a thin dividing web. The recesses are filled with precipitated metallic lead in a perfectly porous state. A cell containing 15 such plates weighs, complete, 25 kilograms, and is said to give an average capacity of 150 ampère hours with a discharge rate of 30 ampères.

We have handled some of these plates, and found them peculiarly tenacious. To show that this precipitated lead can be produced in any quantity, there is a sample block nearly 2 inches thick suspended within a glass jar filled with acid. We are not informed about the method of producing this precipitated lead nor of its cost, but the price list of M. Garassino compares favourably with that of other makers.

The Société Anonyme pour le Travail Electrique des Métaux exhibits several large cells, as well as sample plates and appliances for manufacturing the same. The active material is originally chloride of lead, which is made into blocks of 1½ inches square, rounded off at the edges and corners. A number of these blocks are placed into an iron mould a certain distance apart, and molten lead is cast around them. In order to place them rapidly and at equal distances the blocks are put upon the mould by means of a grid-shaped frame, the openings of which receive the blocks; when filled this grid is removed, leaving the active material in its proper position, when the second half of the mould is put on and the lead poured in. This exhibit suggests careful technical skill, and a good knowledge of the requirements in storage batteries, but it seems that the form of the active material is not the most advantageous; the dimensions of the blocks are much larger than is good for rapid discharges, and there is the probability that much of the intended active material must remain inactive. Yet it is claimed that 9 ampère hours may be obtained per kilogram of plate.

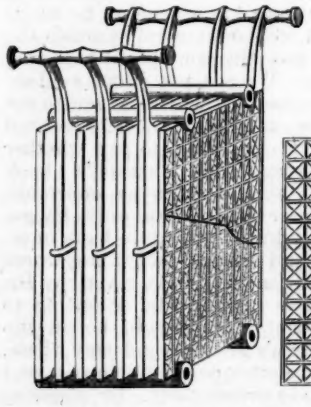


FIG. 3.

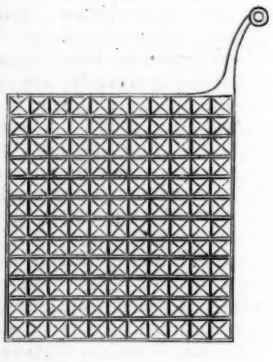


FIG. 4.

M. Dujardin has an accumulator which resembles, in some respects, that of M. Kabath in days gone by. The plates are made up of thin diagonally-indented lead strips, with the ends burned to a lead frame; the edges of said strips form the exposed surface of the plate. Although of the Planté type, it is claimed that these plates can be completely formed in one day by means of the addition to sulphuric acid of some chemical compound. From a casual glance at the dry plates, it would appear as if the same, after being "burned" as stated, had been dipped into a very thin paste of lead oxide, just to fill the slight spaces between the lead strips. Such coating would be thin enough to be "formed" in one day. The plates are placed into the box in the usual way, but the spaces between them are filled with a coarse granular silicate, which is specially manufactured, and is very porous. It is claimed that a cell of 30 cm. by 7 cm., and 27 cm. outside dimensions, having a total weight of 21 kilos.,

gave on discharge 407 watt-hours. The *rate* of discharge is not given ; but the "output" seems very high even at a very moderate current rate.

M. Pollak shows plates of sheet lead, upon which there are numerous projections in the shape of small hooks. The active material, in the form of chemically prepared lead, is pasted upon the plates, and held in position by these hooks. A cell containing 11½ kilogrammes of such plates gives 100 ampère hours capacity at the rate of 20 ampères.

M. Le Jeune has plates made of lead strips, which are subsequently pasted ; no novelty.

M. Peyrusson exhibits several small laboratory cells, oxide of lead, porous pot or bag and zinc ; also a Cadmium cell. No explanation.

M. Aboilard's accumulator appears to contain lead plates wrapped in cloth or felt ; details of construction not visible.

As mentioned at the beginning, England and America are conspicuous by their absence, as far as this industry is concerned. We have sought in vain for the Commelin-Desmazures storage battery, about which Mr. P. Elwell promised so much a year ago, mainly in your columns. If we have missed this, or any other, in spite of our best efforts, we hope that the deficiency may be supplied by those interested.

THE WESTINGHOUSE-EDISON LAMP PATENT SUIT.

LAST week we noted that Judge Bradley, of the United States Supreme Court, had given his decision in the above suit adversely to the complainant, and that as Edison did not infringe the Sawyer-Man patent for fibrous filaments, the case must be dismissed. It is questionable, however, whether, as stated in the cablegram from New York we quoted, the judgment is to be considered a signal triumph for the Edison Company ; for, although the latter company maintain their right to manufacture incandescent lamps, the judge's decision, if supported on appeal, practically destroys all monopoly in the said manufacture.

Judge Bradley, in his decision, says that the case was a bill for the alleged infringement of a patent filed December 8th, 1887, and the patent alleged to be infringed is dated May 12th, 1885, and is for improvements in electric lamps. It was granted on application of Wm. E. Sawyer and Albon Man, of New York, to their assignees, the Electro-Dynamic Light Company, and by assignment was transferred to complainant, whose title commenced in October, 1882, before the patent was issued. The application for the patent was filed January 9th, 1880, and the issuance delayed by various proceedings in the patent office, including an interference with an application of Thomas A. Edison, which had been filed a month earlier, in December, 1879.

Various defences were set up in answer, such as anticipation by prior invention, vagueness of description, want of novelty and utility, undue change of specification after filing, surreptitious claim of an invention made by Edison, &c. In the specification of the patent sued on, called the Sawyer and Man patent, the invention is described as relating to that class of electric lamps employing an incandescent conductor inclosed in a transparent hermetically sealed vessel or chamber, from which oxygen is excluded, and constituting an improvement upon the apparatus shown in a previous patent granted to the same parties (Sawyer and Man) June 18th, 1878, and No. 205,144. It is further stated that the invention relates more especially to the incandescing conductor, its substance, its form, and its combination with the other elements forming the lamp, and that the improvement consists : First, of the combination in a lamp chamber composed wholly of glass, as described in the said former patent, of an incandescing conductor of carbon made from a vegetable fibrous material, in contradistinction to a similar conductor from a mineral or gas carbon, and in a form of such conductor combined in a lighting circuit within the exhausted chamber of the lamp. The construction of the lamp is then described, and reference made to the drawings, the lamp, as shown in drawing, consisting of a glass cylinder fitted into a glass cup filled with wax or other cement to prevent the ingress of atmospheric air. Two wires through the bottom of the lamp convey the current. The carbon conductor within the glass cylinder is connected by its extremities to these two wires, in a mode specified in another patent of Sawyer and Man, dated December 10th, 1878, and numbered 210,809, so as to constitute a part of the circuit, and having a low conductivity, and presenting a certain amount of resistance to the current of electricity it becomes luminous. If the carbon in this condition were exposed to the atmospheric air—that is, to oxygen—it would be consumed. Hence another part of the combination necessary consists in filling the globe with nitrogen gas or other gas, which prevents combustion to the exclusion of ordinary air. The mode of doing this is pointed out in specification 205,144, before mentioned. It is further stated in the specification that in practice the applicants had made use of carbonised paper and also wood carbon ; also that the conductors had been used of different shapes, but that the arch shape as shown in drawing was preferred. It is added that a description of the mode of making the carbon conductors described was unnecessary, as they could be made by any one skilled in the art by the well known methods in practice. The specification also claims the advantages to be gained from making the conductor of an arch shape, the wall of the lamp of glass, and lays stress on the advantage of manufacturing the carbon from vegetable, fibrous, or textile material, instead of mineral carbon. It is stated that the best results were obtained when the carbon was in a vacuum, or in an atmosphere of nitrogen gas.

The patent has four claims :—

"1. An incandescing conductor for an electric lamp of carbonised fibrous or textile material, and of an arch or horseshoe shape, substantially as hereinbefore set forth.

"2. The combination, substantially as hereinbefore set forth, of an electric circuit and an incandescing conductor of carbonised fibrous material, included in and forming part of said circuit, and a hermetically-sealed chamber in which the conductor is enclosed.

"3. The incandescing conductor for an electric lamp, formed of carbonised paper, substantially as described.

"4. An incandescing electric lamp, consisting of the following elements in combination :—First, an illuminating chamber, made wholly of glass, hermetically sealed, and out of which all carbon consuming gas has been exhausted or driven ; second, an electric circuit conductor passing through the glass wall of said chamber, and hermetically sealed therein as described ; third, an illuminating conductor in said circuit, and forming part thereof within said chamber, consisting of carbon made from fibrous or textile material, having the form of an arch or loop, substantially as described for the purpose specified."

The great question in this suit is whether the patent sued on is valid, so far as it involves a general claim for the use in electric lamps of incandescing carbon conductors made of fibrous or textile substances. If it is, the complaint must prevail. If it is not, the Bill must be dismissed.

The giving an arched form to the conductor cannot be considered as new, and could not give validity to the claim that was not broadly covered by the claim of carbon produced from fibrous material. The arched form was applied by Staite in 1848 to an iridium conductor, to a platinum conductor in 1858 by Gardiner and Blossom, and in 1872 by Konn to a carbon conductor. In the last case it was enclosed in a lamp filled with nitrogen ; and though the shape of the carbon presented was V-shaped, a subsequent patent by this inventor says : "It is evident that stems of other shapes can be used." The U-shape given to carbons of fibrous material by Sawyer and Man was merely an application

by them of an old device to a new and analogous purpose. Konn included charcoal as well as other carbons, and claims the use of carbon generally.

Is the complainant's patent valid for such a broad claim of all carbons made of fibrous or textile substances? The defendants contend that it is not, because no such invention was specified in the original application, but was introduced more than four years after it was filed, and after it had been used by Edison, and claimed by him in an application for a patent; and, again, because Edison was the real inventor of a conductor made of fibrous material, and that if he were not, and the thing claimed was old, then neither of the parties were entitled to it.

The whole vegetable kingdom is composed of fibrous material—silk is fibrous or textile, and carbon, therefore, made from either, come within the claim. Can it be said, looking at the history of the art of electric lighting, that carbon made from fibrous or textile material was never used prior to Sawyer and Man did so in 1878? We think not. The word charcoal, in the English language, *prima facie*, refers to coal made of wood. We cannot agree with witnesses for the complainant, that the word has come to have a definite meaning in this particular art, signifying gas or mineral carbon. We think that vegetable carbon is generally intended. King, in 1845, claims "a continuous metallic or carbon conductor, heated intensely by the passage of a current of electricity for the purpose of illumination, and when carbon is used, in consequence of its affinity for oxygen, it is necessary to exclude from it air and moisture. It should be enclosed in a Torricellian vacuum." King does say that retort carbon is suitable, but his claim is for carbon generally, and the use of wood charcoal would have infringed his patent. Green and Staite, in 1848, describe a carbon made from powdered lamp black, or charcoal. This charcoal is clearly wood charcoal. Roberts, in 1852, claims a mode of passing an electrical current through thin pieces of graphite, coke, or charcoal, or other infusible conductor, while it is enclosed in a vacuum of space not containing any oxygen or other matter that can cause its destruction when it is in an incandescent state. This certainly refers to vegetable charcoal. We have already alluded to Konn's patent of 1872. In the earliest experiments of Sir Humphrey Davy and others, in the production of the electric light by the passage of electric currents, charcoal was frequently used. Long prior to 1878 it was a well known fact that the transmission of an electric current through a pencil of charcoal, interposed in a metallic circuit, would produce an intense light; and that when this charcoal was protected from contact from oxygen, in a vacuum or otherwise, it would not be consumed. This is fully verified, not only in scientific writings, but by the statements found in several of the patents referred to. The great desideratum was to construct an apparatus and to discover a process which would make the light economical and convenient for domestic use.

We are clearly, therefore, of opinion that neither Sawyer and Man, nor Edison can maintain any just claim to the exclusive use of charcoal generally in any form as an incandescing conductor in an electric lamp. This view of the subject is sufficient to decide the present case against the complainant; but there are other considerations which corroborate this conclusion, which we shall cursorily examine.

In the original application for the patent sued on, there is nothing on which to base the claim of all carbon made from fibrous or textile material. Having carefully compared it with the amended application on which the patent was issued, it is evident that after the publication of Edison's inventions on this subject, there was an entire change of base on the part of Sawyer and Man, and that the application was amended to give it an entirely different direction and purpose from what it had in the original. The last claim of the original, it is true, was for "an illuminating arc," made of "carbonised fibrous or textile material." But this refers to the arched form of the conductor, rather than to the material of which it was composed. This is the only mention in the application which can even suggest an exclusive right to all vegetable carbons; no advantage is claimed for use of said carbon, and the whole scope of the application relates to the arched form of the conductor. For a subsidiary purpose they claim carbon made of pasteboard. They say distinctly: "Our improvement consists in the employment of an incandescent arc of carbon in the circuit as a light-giving medium." "Carbon" generally, not any particular carbon. Adroitly amended in 1885, they say: "Our improvement relates more especially to the incandescing conductor, *its substance*, its form, and its combination with the other elements forming the lamp." The purpose of this amendment is obvious, and requires no comment. In the original application the arc is everything, the changes are rung in the arc. The fact is, that Sawyer and Man were unconscious that the arc was not new, and was patentable, but as their eyes were opened they made the carbon the main object, a fibrous carbon in contradistinction to gas and mineral carbon. The correspondence of the parties show that the subject was spoken of as the "carbon arch matter" when the application was made for the patent on January 8th, 1880. Edison had filed an application in December, 1879; and in September, 1880, an interference was declared between the two applications. The controversy chiefly related to carbon made from paper. In 1885 the case was decided in favour of Sawyer and Man.

Mr. Broadnax, the plaintiffs' attorney for the application for the patent, says, in his evidence in the present case, "I resumed the prosecution of the application insisting upon our right to the claims that had been once rejected by the examiner, among which was one for the U-shaped carbon. My attention was then first called to the British patent of Konn, in which is shown an arched-shaped carbon, which I considered broadly anticipated the claim for a U-shaped filament, and in the discussion which followed with the examiner my attention was called to the patentability of the fibrous carbon illuminant as such." This was in February, 1885.

This testimony shows that the claim for carbons of a fibrous material was an afterthought. And we are of opinion that the changes in the application were not justifiable, and that the claim cannot be sustained.

Judge Bradley, having thus declared against the complainant's patent, proceeded to state that, in his opinion, Edison was the great discoverer who made incandescent light possible, by his adoption of long slender filaments enclosed in a vacuous globe made of one piece of glass. After quoting largely from Edison patents, dated from April, 1879, to November 4th, 1879, in proof of his assertion, he concludes his judgment in the following words:—

"We think we are not mistaken in saying that but for this discovery, electric lighting would never have become a fact. We have supposed it to be the discovery of Edison, because he has a patent for it. This may not be the case; it may be the discovery of some other person. But, whoever discovered it, it is undoubtedly the great discovery in the art of practical lighting by electricity. We have given a more detailed account of it in order to illustrate what we mean when we raise the question whether the claimed inventions of Sawyer and Man were ever successful. They may have made a lamp that would burn; but was it a success or was it a failure? Did it ever go into use? What was the object of all the experiments made by them and others? Was it not to make an electric lamp that could be successfully used by the public, and have a commercial value? Did they succeed in making such a lamp, or in finding out the principle on which it could be made? We do not so read the evidence."

The bill must be dismissed.

Memorial to the Late Dr. Joule.—A movement is on foot for the erection of a memorial in Westminster Abbey.

ON THE CHOICE OF CABLES FOR ALTERNATING CURRENTS.

THOSE electricians, writes M. Ch. Jacquin in *L'Electricien*, that have occupied themselves with alternating currents have long discussed, and are still discussing, the choice of cables to be used. When alternating currents were utilised for the first time, *i.e.*, for supplying the Jablochkoff candles, ordinary cables were employed. Since then, owing to the employment of transformers, the use of alternating currents has largely increased, and many canalisations traversed by these currents have been made. Some theorists then expressed the opinion that instead of employing simple cables, *i.e.*, two separate conductors, one going out and the other returning, it would be far preferable to have a single concentric cable, the central core forming one of the conductors, and the other consisting of a ring insulated from the core.

In such a cable the two conductors are at each moment traversed by currents of a contrary nature, consequently the two fluxes of opposite natures constantly neutralise one another and give rise to no line of force outside the conductors. Thus these cables produce no hurtful induction on telephonic lines. Moreover, if they are covered with a metallic armature, this is not the seat of any parasitic current. A simple cable, on the contrary, produces a variable circular, magnetic field. If it is covered with a metallic armature, it gives rise in this latter by induction to phenomena of hysteresis, Foucault currents and induction currents resolving themselves into a loss of energy. Many believing these losses to be excessive, have thought that armoured cables should for this reason be concentric.

If it is true that concentric cables save us from induction, they offer in other respects serious inconveniences. The electrical stations at Berlin and elsewhere soon found this out. Defective insulation between the core and the annular ring gave rise to serious accidents. The cause of these accidents is easily understood. In a concentric cable the difference of potential between the two conductors is double that which exists between the core of a simple cable and the earth. The insulation between the two conductors of the concentric cable should therefore have an insulation of at least twice the value of that of a simple cable. Now, in the first concentric cables the insulation was far from being equal to that of the simple cables, for the makers, in the manufacture of them, had employed as a dielectric merely textile fabrics impregnated with pitchy substances.

If we wish to have concentric cables sufficiently insulated, we must use very thick layers of gutta-percha, which are very difficult to vulcanise at their periphery, and then the cables become very expensive. Thus the concentric cables for the municipal works of the market places cost 33 francs per metre, whereas the corresponding simple cable costs 8·35 francs. Thus canalisation will cost 33 francs per metre with the concentric cable and 16·7 francs with the simple cable, *i.e.*, canalisation with the concentric cable will be twice as dear.

In the face of these figures, many have asked themselves whether it would not be better to return to the simple cables. In order to answer this question it was necessary to ascertain whether the loss of energy, which is evidently always produced in a simple armoured cable, was really so great as to necessitate the employment of concentric cables. The question was too complex to allow of any figures being fixed *à priori*; it was therefore necessary to proceed to direct experiment.

This is why we performed the unpublished experiments that we will now describe. We need not be surprised that no experiments of the kind have as yet been made; these trials require a considerable amount of expensive material and apparatus, all of which M. Henri Menier placed at our disposal in his works at Grenelle.

The plan of the installation is represented in fig. 1. A length of cable of 200 metres, unwound upon the ground, may be traversed either by the alternating currents from the dynamo, D_1, or by the continuous currents from the dynamo, D_2, by means of the commutator, C. In the circuit are placed a rheostat, P, an electro-dynamometer, A, and the fixed bobbin of a wattmeter, W. The movable bobbin of this latter is connected with the terminals, *m*, *n*, of the conductor.

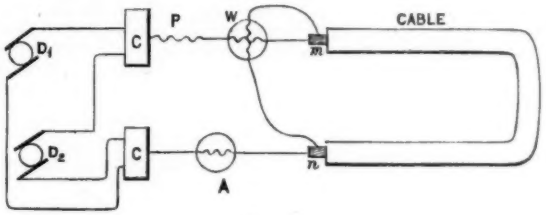


FIG. 1.

First we send into the cable the alternating current of D_1. If the cable is armoured, phenomena of hysteresis, induction currents, and Foucault currents are produced in the armature, having the effect of creating a counter-electromotive force in the conductor; so that in order to obtain an effective intensity, I eff., in this conductor, it would be necessary to place at the terminals of the cable a difference of potential above that (R I eff.) given by Ohm's law. The deviation, *a*, of the wattmeter will then give the total power, P tot, expended in the cable, as much by the resistance of the conductor as by prejudicial actions in the armature for an effective intensity given by the electro-dynamometer, A.

We then substitute for the dynamo, D_1, the continuous current dynamo, D_2. We bring it to the same intensity, *i.e.*, to the same deviation of the electro-dynamometer. We read the slighter deviation, *a'*, of the wattmeter. The current being continuous, there is no induction in the armature; the wattmeter then measures simply the power expended (R I^2 eff.) by the resistance of the conductor.

The power dissipated (P diss.) in the armature is determined by the two experiments

$$\text{P diss.} = \text{P tot.} - \text{R } I^2 \text{ eff.}$$

But what is especially interesting is not the absolute value of the power dissipated as much as the ratio of this power to the power R (I^2) mean expended in the conductor.

This ratio,

$$\frac{\text{P diss.}}{\text{R } I^2 \text{ eff.}} = \frac{a}{a'} - 1,$$

depends only on the ratio of the deviations of the wattmeter; this latter need not therefore be calibrated exactly.

These are the results obtained with an alternating current of 5,000 periods per minute.

If we make the alternating current pass into a cable without an armature, wound upon the iron bobbin which serves to transport it, the power dissipated in this bobbin is equal to ten times the power expended in the conductor. This shows of what importance the parasitic currents are when the mass of iron is not divided.

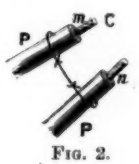


FIG. 2.

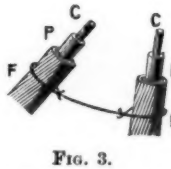


FIG. 3.

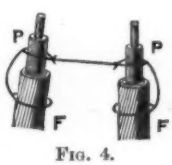


FIG. 4.

P, lead; C, copper; F, iron.

Once unwound, the cable without an armature expends no more with the alternating current than with the continuous current, as is evident.

In a cable under lead, the loss in the envelope of lead, even when the two extremities are connected, fig. 2, is only 1 or 2 per cent. of R I^2 eff., as no hysteresis is produced and the magnetic field is feeble.

We then worked with a cable covered with a leaden tube, then with a hempen cushion, with a strand of iron wires, and lastly, with a fabric impregnated with pitch. When the cable is laid in trenches, the tarred material does not insulate, so that the iron is, throughout its length, in communication with the earth; this is why, after having left the armature insulated upon the earth by the tarred cloth, we connected the two extremities of the iron by a wire of slight resistance, fig. 3. The lead being only separated from the iron by very slightly insulating wire, a communication may be established between them.

In order to make the conditions as unfavourable as possible, we connected by a copper wire the envelopes of lead and of iron, and then the two armatures together as shown in fig. 4.

The following figures relate to each of these three cases:—

Insulated armature

$$\frac{\text{P diss.}}{\text{R I}^2 \text{ eff.}} = \cdot 18.$$

Extremities of the iron connected

$$\frac{\text{P diss.}}{\text{R I}^2 \text{ eff.}} = \cdot 28.$$

Lead and iron in parallel, armatures connected,

$$\frac{\text{P diss.}}{\text{R I}^2 \text{ eff.}} = \cdot 35.$$

When the armature is insulated only phenomena of hysteresis and Foucault currents are produced; the loss is only 18 per cent. When, on the contrary, the armature forms a closed circuit, it constitutes the secondary circuit of a transformer; an induction current is developed in it all the more intense as the resistance of this circuit is feebler; thus, with the armatures connected, the loss is from 28 to 35 per cent. It may be remarked that this last case is not frequent in practice, for the resistance between the iron and the lead can never be altogether disregarded. Thus 35 per cent. is a maximum.

These figures relate to a current of 3,000 periods per minute. With currents of 6,000 to 7,000 periods per minute, the loss in the armature would evidently be greater. We may say that the loss in a cable under lead is 2 to 3 per cent.; in a cable with lead and iron, the loss in the armature reaches the high maximum of 45 to 50 per cent. of the power expended in the conductor. Moreover, it must be remarked that cables for alternating currents are almost always traversed by currents of high tension, and that the loss in the conductor never reaches more than 5 per cent. of the total power produced by the machine. Considered from this point of view, the supplementary loss due to an envelope of lead may be entirely disregarded. In a cable containing lead and iron, the loss due to the armature is at its maximum 2·5 per cent. of the total power supplied to the works.

It follows from these experiments that it is always more advantageous to employ simple cables, even with armatures than concentric cables, and we need not fear a detrimental effect upon the neighbouring telephonic lines. In fact, the loss due to the armature is comparatively slight, and the canalisation costs half as much.

The advantage becomes incontestable when we only employ a covering of lead, since a simple cable of this nature does not expend appreciably any more than a concentric cable. In practice, we can in many cases content ourselves with a tube of lead; we substitute for the iron armature another mechanical protection, such as an earthenware tube or a tube of impregnated wood.

Burglary at Messrs. Woodhouse and Rawson's.—William Robinson and William Evans have been committed for trial on the charge of breaking and entering the premises of 12, Sise Lane, and stealing instruments the property of the above firm.

REVIEWS.

Elementary Manual of Magnetism and Electricity. By Prof. JAMIESON. Part I.—Magnetism. London: Charles Griffin & Co., Exeter Street, Strand.

This manual is written more especially to cover the elementary stage of the Science and Art Department's examination. The plan of the book is generally a description of experiments, and then a series of questions on the former. The illustrations are very numerous, and in many cases original; and many of the experiments described, which have important practical bearings, we do not recollect having seen in any other textbook. An important appendix on "Practical notes on making experimental apparatus for studying magnetism" is given at the end. There is nothing which so indelibly stamps an impression on a student's mind so much as the construction of the apparatus to illustrate a law or laws. Altogether we must congratulate Prof. Jamieson on having brought out a book which is of marked value.

A Dictionary of Electrical Words, Terms and Phrases. By E. J. HOUSTON. W. J. Johnston Company, Limited, Times Building, New York.

Although the present work is not the first of its kind, it is by far the best that has yet been published, and the name of the author is a sufficient guarantee of its excellence. In compiling the book, a concise definition of each word, term or phrase is given; also a brief statement of the principles of the science involved in the definition, and lastly, where possible and advisable, a cut of the apparatus described or employed in connection with the word, term, or phrase defined. In many respects the compilation is more than a mere dictionary; it is an abbreviated Encyclopædia. Thus, for example, under the heading of Telegraphy—Synchronous Multiplex—Delany's system, we have 5½ pages, with illustrations, devoted to a description of the arrangement. In this particular case the description is diffuse (unavoidably so, we think), but as a rule conciseness is, with few exceptions, admirably effected. Altogether the work is deserving of great commendation, and does the author much credit. It should be mentioned that the book is naturally compiled mainly from an American point of view, *i.e.*, descriptions of English and Continental apparatus are wanting in many cases; thus we do not find the Wheatstone fast-speed apparatus mentioned. No doubt this and similar omissions will be remedied in future editions.

The Law Relating to Electric Lighting. By G. SPENCER BOWER and WALTER WEBB. London: Sampson Low, Marston, Searle, and Rivington, Fetter Lane, Fleet Street, E.C.

This work is a second edition of the one written in 1882, shortly after the passing of the Electric Lighting Act of that year. The scheme of the book is as follows:—In the introduction a short history of Parliamentary action with regard to electricity from 1879 to 1888, prefaces an account of the general framework, scope, and intent of the Acts, in which the various topics are classified, and the questions raised are treated in their natural and logical order. The introduction is followed by the two Acts of 1882 and 1888, arranged together as one code. Each of the sections of the Acts is followed by notes on the same. Four appendices contain the Board of Trade rules with reference to applications for licences and provisional orders; the model form of provisional order; the recent regulations of the Board of Trade relating to overhead wires; and certain regulations and conditions issued and applied by the Board of Trade to the Liverpool Licence, 1888. A copious general index concludes the book.

Solutions to the Questions set at the May Examinations of the Science and Art Department, 1881—1889. *Machine Construction*. By HENRY ADAMS, Professor of Engineering at the City of London College. London: Chapman and Hall, Limited.

The solutions to the questions consist entirely of a series of diagrams (placed in a pocket in the cover of the book). The diagrams are well got up, and will give any student an excellent idea of the way in which he is expected to give his answers, *i.e.*, to make his drawings.

Sound, Light, and Heat. By ALFONZO GARDINER. Part I., Elementary Stage. 16th edition. London: John Heywood, 1, Paternoster Buildings.

The first edition of this work was published in 1872, and the fact that it has now reached its 16th edition renders any comment unnecessary. All the questions set in the elementary stage of the Science and Art Examinations in the subjects are more or less fully answered, and great attention has been paid to the correct working of arithmetical questions. The examination questions down to 1888 are all given. The value of books of this kind is, we think, unquestionable.

PROPOSED ELECTRIC LIGHTING AT CROYDON.

AN important discussion on the subject of electric lighting took place at the last meeting of the Croydon County Council. Mr. OELRICHS moved, in accordance with notice, "That the Council apply for a provisional order giving to the corporation electric lighting powers for Croydon, and that it be referred to the General Purposes Committee to report as to the necessary details of the application." The speaker said he had carefully studied the subject of lighting Croydon by the electric light, and he did not wish to involve the corporation in any hazardous speculation. He simply wanted them to light the streets themselves, or do so under contract with some company under the corporation's own lighting powers, and thus avoid a monopoly, which was invariably objectionable and prejudicial to the interests of ratepayers. The present cost of 1,750 gas lamps of 10 C.P. each was £6,300 a year, the total C.P. being 17,500. This rather large outlay might be considerably decreased by adopting the electric light, the cost of which would not exceed £6,000 per annum. He had been in communication with several well-known electric lighting firms, and their figures showed conclusively that that estimate was absolutely safe. The private electric lighting of the town would, in the event of the corporation obtaining the necessary powers, prove an important addition to the revenue of the town. It was the time for electric lighting now, and he had received a letter from the Borough Surveyor of Hastings, stating that he had just succeeded in getting the corporation to apply for a provisional order to enable them to illuminate the streets of that town by electricity. Chelmsford and other towns were doing the same.

The motion was seconded.

Dr. CARPENTER, while not agreeing with the resolution, was certain that the introduction of electricity into Croydon would greatly improve the health of the town. He was opposed, however, to the corporation taking up trading operations as a source of profit, for he thought that the surplus money above a certain limit should be employed in cheapening the light. He hoped, however, that if the Council rejected the resolution they would not permit the electric lighting question to suffer in consequence.

Ald. HAGGIS moved as an amendment "That it is undesirable at the present time for the corporation to seek powers to supply electricity to the borough, notice having already been given by three companies of their intention to apply forthwith for provisional orders for that purpose." He considered, to do the thing thoroughly, it was necessary to lay down one central station. It would prove a very costly experiment to attempt it in any other way. £4,000 or £5,000 would be totally inadequate for laying down mains, providing machinery, and keeping the whole work going for a year. Besides having to lay down two mains, one for public and the other for private purposes, they would also have to use two sorts of wire. In fact, the scheme was impracticable, unless they decided to supply the town as well. He would ask them to reject the resolution and allow the companies to get the provisional orders, carry out the works, and let the Council see how it was done. He had no objection to the Council coming to terms with the company that obtained the order, but he strongly objected to their entering upon the work themselves.

Mr. SCHMITZ seconded the amendment which, after further emarks, was carried.

OVERHEAD WIRES AND SUBWAYS.

PROPOSED BILL FOR THE COUNTY COUNCIL.

AT the meeting of the London County Council on Tuesday last at the Guildhall (Lord ROSEBERY in the chair) a short interesting discussion ensued upon the presentation by Mr. A. H. HAGGIS of the following report of the Highways Committee:—

"Your Committee have had under their consideration the following resolution of the Council of 11th April last.

"'That as overhead wires, which are daily on the increase in the metropolis, are under no control whatever, the local authorities having no legal power to interfere unless actual obstruction or danger is proved, and as no means exist of identifying or dealing with ownerless wires, it is expedient that all overhead wires should be brought under legislation.

"'That this Council should be constituted the authority for making bye-laws for the registration, regulation and inspection of all such wires; and that it be accordingly referred to the Highways and Parliamentry Committees to confer, and report as to the steps to be taken with this object.

"'The cognate question of subways has also on many occasions been considered by your Committee, and they are of opinion that in the interests of the inhabitants and the trade of London, the Council should have power to construct subways, when favourable opportunities occur, under the principal streets, and to regulate, and charge for, their use; and that the Council should also acquire more extended powers in regard to subways at present existing. They have received reports on both subjects from the engineer and solicitor, and have conferred with the Parliamentary Committee; and, as the result, recommend—

"'That, subject to the recommendation of the Finance Committee that the necessary costs be incurred, it be referred to the Parliamentary Committee to prepare and introduce into Parliament in the ensuing session, a Bill conferring the following powers, amongst others, upon the Council, viz.—

"'(*a*) *As to Overhead Wires.*

"'1. To compel owners of existing wires to register same, with route plan and other particulars, at the office of the Council within twelve months of the Bill becoming law, such register to be corrected annually.

"'2. To require, in the case of new wires, plans to be submitted for approval of Council before erection.

"'3. To remove ownerless wires.

"'4. To call upon owners to make alterations, repair defects, or renew.

"'5. To make bye-laws and regulations as to length of span across roads and streets, height, mode of support, material and gauge of wires.

"'6. To authorise, in special cases, attachments to private property, subject to the question of compensation or payment by the wire owners for such privilege, and to the attachments not interfering with the free use of the property.

"'7. To employ inspectors.

"'8. To prescribe that wires can be carried underground.

"'9. To charge a fee for annual registration.

"'(*b.*) *As to Subways.*

"'1. To construct subways of such form and size in such thoroughfares or streets, and at such convenient times, as the Council may deem desirable.

"'2. To compel owners of gas and water or other pipes and wires to use subways where made, and to remove existing pipes and wires into subways.

"'3. To charge rent for use of subways, and grant use of subways free for a given period as compensation in case of compulsory removal.

"'4. To acquire, by agreement, the whole or portions of vaults or cellars under public streets when required to enable subway to be constructed.

"'5. To alter, for the purpose of construction of subways, the position of sewers, pipes, wires, or other works in streets, on payment of actual cost only of structural alterations.

"'6. To call upon gas and water and other companies to supply plans and full particulars of any pipes, wires, or other works belonging to them in any streets along which it may be suggested that subways should be laid.

"'7. To call upon gas and water and other companies to deposit plans and obtain the approval of the Council for any proposed alteration, renewal, extension, or addition, to existing pipes, wires, or works in any thoroughfare or street.

"'8. To remove all disused pipes or works in public streets.

"'9. To make regulations for the use of subways.'"

Mr. HAGGIS said that although it was late in the evening he was quite prepared to make a statement on the important subject if the Council were ready to discuss the question.

Sir THOMAS FARRER asked whether the committee had considered the expediency of giving any of the powers to district councils?

Mr. HAGGIS replied that with regard to overhead wires it was much better that they should be under the control of one body rather than that they should be divided amongst a number. Overhead wires went through several districts, and it would not be at all a right thing to submit the owners of the wires to the authorities of several districts, and to a variety of different rules and regulations. The Council had thought over the matter, and saw several difficulties in the way of district councils having the control

of the overhead wires, and thought it should be reserved to the Central Council.

The CHAIRMAN, in reply to questions, stated that the subject was one which should be decided that evening as the Parliamentary Committee were awaiting instructions.

Mr. HAGGIS expressed the belief that the provisions suggested as to overhead wires would be accepted, not only by the public at large, but by those who owned the wires. In the Parliamentary inquiry which took place four years ago, when the Select Committee took evidence as to overhead wires in London, the companies, by their witnesses, admitted that they would much prefer to be under some control Recommendations were then made by the Select Committee, and those in the report, he submitted, were based upon the report of that committee. He thought that so far as overhead wires were concerned there need be little discussion.

Mr. BERESFORD HOPE, M.P., wished to know what was meant in regulation No. 6, by "attachments to private property." Did that mean compulsory attachment to private property?

Mr. HAGGIS: That is so. There had, he said, in some cases been arbitrary objections to allowing attachments to houses, and the committee considered it advisable in extreme cases that the Council should have the power to compel attachments. Of course, there would be proper safeguards.

Mr. BERESFORD HOPE desired further to know if it was to be left to the discretion of the Council to decide as to what were extreme cases?

Mr. HAGGIS answered that there would be a special clause dealing with the point.

Mr. CHARRINGTON said that if, as he believed there was, a general desire to do away with overhead wires, why have the clause at all?

Mr. HAGGIS remarked that if the committee saw their way to doing away with overhead wires, they would be glad to do so.

Mr. BOULNOIS, M.P., expressed the opinion that the question of subways was so important that it ought not to be rushed through by the Council.

The CHAIRMAN suggested that the recommendations of the committee should be agreed to provisionally and that the discussion should be reserved for the Bill when brought up.

Mr. CLARKE urged that the question of overhead wires should be settled at once, as the electric telegraph companies would be in force next year.

After further discussion, the recommendations of the committee with reference to overhead wires were agreed to.

Mr. C. HARRISON then moved a resolution as to subways, to the effect that the powers should be such as the Council might hereafter agree to.

This was carried and the subway recommendations were thus provisionally accepted.

THE ELECTRICAL AND INDUSTRIAL EXHIBITION, BIRMINGHAM.

AWARDS TO THE ELECTRICAL AND ALLIED TRADES, &C.

First Class Gold Medals.

ELECTRICAL SECTION.

Class I.—Lighting and Power.

1. Anglo-American Brush Corporation, London, alternating current dynamos and transformers, lighting, and general exhibit.
2. Buller, Jobson & Co., Dudley, Henley, and London, insulators.
3. Crompton & Co., London and Chelmsford, electric crane and incandescent lighting dynamos.
4. Elwell-Parker, Limited, Wolverhampton, accumulators and lighting.
5. The Edison and Swan Co., London, incandescent lamps.
6. Goldston, A. A. Middlesboro', series arc and incandescent lighting, and exhibit.
7. Lacombe & Co., London and Paris, electric light carbons.
8. Laurence, Paris and Scott, Norwich, dynamos and motors.

Class II.—General.

1. Avery, W. and T., Birmingham electrical weighing machine and bells.
2. Fowler, Lancaster & Co., Birmingham, electric fittings in china.
3. Tullis & Co., Birmingham and Glasgow, link belting.

INDUSTRIAL SECTION.

Class I.

5. Wiggin, H. & Co., Birmingham, nickel.

First Class Silver Medals.

Class I.—Lighting and Power.

1. Acme Electric Company, electrical fittings for electric lighting.
2. Appleton, Burbey and Williamson, main switches and general exhibit.

2a. Electrical Power Storage Company, London, accumulators.

3. Fowler, J., & Co., Leeds, lead covered cables.
4. Glover & Co., Salford, wires and cables (lighting and telephonic).
5. Henley's Telegraphs Company, London, wires and cables (submarine).
6. Immisch & Co., London, motors.
   Muller, Bradford, instruments and carbons.
7. Scott, E., & Co., Newcastle-on-Tyne, parallel arc lighting.
8. Statter, J. G., & Co., London, constant current dynamo and general exhibit.
9. Woodhouse and Rawson, London, electrical apparatus for lighting.
10. Campbell Gas Engine Company, Halifax, gas engines.

Class II.—General.

11. Canning & Co., Birmingham, electro-plating.
12. Davis & Son, Derby, outdoor electric light fittings.
13. General Electric Company, general exhibit.
15. Nalder Bros., London, electrical instruments.
16. National Telephone Company, telephone apparatus.

16a. Piercy & Co., Birmingham, Griffin gas engine, telephone apparatus.

17. Sax Julius, London, electrical fire alarms, &c.

INDUSTRIAL SECTION.

Class I.

1. Automatic Standard Screw Company, Halifax, screws and terminals.
5. Britannia Company, lathes, &c.

Class II.

7. Price's Patent Candle Company, London, lubricating oils.

Class III.

9. Swinden and Sons, Birmingham, non-magnetic watches and general exhibit.

First Class Bronze Medals.

ELECTRICAL SECTION.

General.

1. Coad, T., London, primary batteries.
2. Conradty, C., carbons.
3. Hartley & Co., Birmingham, electro-plating.
4. Myatt and Pullinger, Birmingham, electro-plating.
5. Mayfield & Co., London, Wimshurst electric machine.
6. Barker & Co., gas engines for electric lighting.

INDUSTRIAL SECTION.

Class I.

1. Armfield & Co., Ringwood turbines, &c.
9. Richardson, R. J., Birmingham, pulley blocks and wrought iron pulleys.
10. Rosendale Belting Company, Birmingham, belting.
11. Small, West Bromwich, machinery oils.

SPECIAL AWARDS.

Gold Medal.

Galloways, Limited, Manchester, boilers.
Greenwood and Batley, Leeds, Armington and Sims engine.
Robey & Co., Lincoln, small high-speed engines.
Ruston, Proctor & Co., Lincoln, compound engine.
Thomson-Houston Co., London, electric arc lighting system.

Silver Medals.

Unbreakable Pulley Company, Birmingham, mill shafting bearings and wrought iron pulleys.
Lister, Birmingham, compound non-conducting composition for steam pipes.

Hyde Park Electric Works, Glasgow.—The recently-formed firm of Messrs. Anderson, Campbell, and Munro have started business at the above address, and are already tolerably busy. They are putting in 80 lights at a new power-loom factory at Dalston, near Carlisle, belonging to Messrs. R. R. Buck and Sons. These are to be worked from the mill engine, which is not fully loaded, and is well governed. The firm are also engaged in re-wiring and remodelling the electric installation at the Glasgow works of Messrs. Arrol & Co., the contractors for the Forth Bridge. We understand that Mr. Campbell has devoted some attention to the construction of electro-magnetic machine tools, and has devised an improvement by which the holding-on magnets serve also as field magnets of the motor. The result of this is that less current is needed, and the weight of the tool is reduced, a machine weighing 42 lbs. being capable of drilling holes half an inch in diameter. These tools are coming into use in connection with shipbuilding, as they can be operated in positions where the work could not be done by other means.

NOTES.

Electric Lighting at Bournemouth.—The Bournemouth Improvement Commissioners have decided to appoint a special lighting committee for the purpose of visiting the electric lighting works at Bourne Valley, to ascertain the arrangements they propose making in order to light the town with the electric light. The committee will not give preference to any company, but will duly consider any invitations which other electric lighting corporations may make to them.

A Country House Lit by Electricity.—Sir Horace Davey's country residence, Verdley Place, Fernhurst, is being fitted throughout with the electric light. The installation, which has been entrusted to Messrs. Crompton & Co., electric lighting engineers, London, will include a circuit of 250 lights. The plant consists of a generating engine, a dynamo, accumulators, and incandescent lamps. The arrangements are to be very complete, as every room, as well as the stables and gardens, will be illuminated.

Electric Lighting in Germany.—The authorities of Gevelsberg (West Germany) are asking for tenders for the lighting of the town.

Electric Light in Newcastle.—Although the electric companies of this town have completed their central stations, they have not yet been granted the necessary legal powers for laying the wires.

Hotel Lighting.—The Imperial Exeter Hotel at Bournemouth is now lighted with the electric light.

The Electric Light in the Royal Navy.—It having been found during the recent naval manœuvres that the electric search lights on ships of the M class were awkwardly placed, the Admiralty has decided to adopt the suggestion of Captain Wilson, of the *Vernon*, with the view of remedying the defect. In place of the towers, which are very inconvenient, owing to the seas breaking against them, flooding the bridge and giving the vessel such a vibration that the guns would, in case of necessity, probably be powerless, a portable platform will be shifted inboard, so that the electric light may only be used when actually required. This arrangement will give the ships extra stability, and the search lights will not be too much in evidence during an action. The new plan is shortly to be tried on the *Marathon* and *Magicienne*, and the work, preparatory to the experiment, is already proceeding.

Taunton Electric Lighting Company.—This company, at a meeting on Monday, decided to increase the capital by creating 2,000 new shares of £5 each. This course had become necessary, it was stated, because of the increased demand for the electric light by consumers, to meet which new plant had to be laid down and larger premises erected. The managing director, Mr. Massingham, said the electric light was supplied to consumers in Taunton cheaper than in any town in England, with the exception of Bath and Exeter, where the charges were the same.

Electric Lighting in Glasgow.—Messrs. Anderson and Munro (who are not to be confounded with the new firm of Anderson, Campbell and Munro) are lighting the Royal Lunatic Asylum at Gartnavel, as mentioned elsewhere, and are also doing a considerable business in the lighting of mansions in the country, as well as in some of the large mills in the Hawick and other manufacturing districts. The handsome business premises which have been erected in Buchanan Street, Glasgow, are to be lighted electrically by Messrs. Norman and Son.

Electricity in America.—Revere is the only town near Boston that is not lighted by electricity.

Rochester and the Electric Light.—The Chatham, Rochester and District Electric Lighting Company, Limited, has given notice of their intention to apply to the Board of Trade for a provisional order on or before the 21st December next. The Town Council have decided to adopt electric lighting for the municipal buildings. The Vines Congregational Church will in future be illuminated with the electric light. This is stated to be the first place of public workship in the county to adopt the light.

Electric Railways.—The horse railway companies in Lowell, Mass., have petitioned the City Council to be allowed to operate their roads by electricity.

Hull and the Electric Light.—Several companies have applied for provisional orders for the lighting of the borough.

Transmission of Power in Factories.—A factory covering a considerable extent of ground, and five storeys in height, is being built at Leeds for the firm of J. and W. Campbell & Co., of Glasgow, the intention being to concentrate there the large business done by this firm in the manufacture of "ready-made" clothing. In this building there will be about 800 sewing machines, as well as the necessary number of cutting machines to keep these going. All these will be operated by electric motors, it having been found on calculating the relative cost that it will be more economical to fit up the building in this way than to furnish it with shafting and all the necessary adjuncts of belting and other things. The fabric also does not need to be so massively constructed, so that there is a considerable economy in the initial outlay. The working cost will obviously be less, as in the case of shafting it would be one man's work, in a concern of this magnitude, to keep everything in order and the bearings lubricated. The contract for the electrical equipment has been given to Messrs. McCulloch, Sons, and Kennedy, of Kilmarnock, who occupy the advantageous position of being able, not merely to supply, but to construct at their own works boilers, engines, dynamos, and motors, as well as arc lamps for illumination.

Technical Students in Glasgow.—The students attending Prof. Jamieson's classes in Glasgow are steadily increasing. A week ago they stood as follows: Steam and steam engine, 190; applied mechanics, 190; electricity lectures. 151, and electrical engineering, 116. There are also 33 day students.

Electricity at Barnum's Show.—The electric light will play a great part in the scenic effects of this big show at the Olympia. On the top of the roof a powerful electric search light of 25,000 candle-power will flash at intervals the name of Barnum over the metropolis.

Keynsham.—The opening meeting in connection with the Working Men's Conservative Association took place on Friday night last. Mr. J. H. Clifton presided, and he was supported by Mr. Evan H. Llewellyn, M.P. for North Somerset. For the occasion it was decided to illuminate the public hall in which the meeting was to take place with the electric light, and Messrs. King, Mendham & Co., of Bristol, were requested by Messrs. Parfitt and Son, Keynsham, at a very short notice, to put down the required plant. The lighting of the building and approaches was effected by means of arc and incandescent lamps. A set of accumulators was telegraphed for, and the Electrical Power Storage Company, promptly responding, forwarded down a sufficient number of cells to effectively light a portion of the interior and to illuminate a large crown placed behind the speakers, while a dynamo driven by a traction engine in a field close by afforded current for an arc lamp judiciously placed in the roof. The lighting was in every way a success, and great interest was evinced by the inhabitants of Keynsham, who had never before beheld such an illuminant in their midst.

The "Victor" Turbine.—The Académie Nationale of France has just awarded its gold medal of the first class for this turbine.

Telegraphy in Belgium. — Fifty-nine thousand messages were transmitted during the month of September in Belgium.

Bad Gas Lighting.—The inferior illuminating power of the gas at Bournemouth has recently been the theme of universal complaint, as in many other towns. Tests which were made about a week ago showed the average candle-power to be 14·12, barely over the minimum quality the company is permitted to supply. On a report to this effect being made to the Commissioners, Mr. White said he considered that the ratepayers showed their sense at the recent poll in not purchasing the gas works at a high price. Bournemouth ought not only to encourage the electric light, but promote a company for producing it.

Section Work at the British Association.—Dr. Oliver J. Lodge, writing to *Nature*, raises the question whether it is not advisable to alter the present inconvenient hours of the meeting of sections, which ordinarily commence at 11 and finish at 3, without any break whatever; he suggests that the meetings be from 10 till 1.30, and the sectional committee meet at 2.30. This is doubtless a very good suggestion, and we trust the British Association will give it due consideration.

Electrical Supplies.—Messrs. Ernest Scott & Co., Close Works, Newcastle, have issued a very complete list of electrical apparatus for lighting, plating and transmission of power. It contains over 100 pages of matter, and the catalogue should be in the hands of every contractor.

The Proposed Electric Tramway between Bournemouth and Poole.—Mr. Haynes, the principal promoter of the Bournemouth and Poole Electric Tramway, has attended before a committee of the Bournemouth Improvement Commissioners for the purpose of explaining the details of the proposed line. The committee have promised to make a careful inspection of the road to be traversed by the new line before they make any final recommendation on the subject.

Telegraphists and their Grievances.—Last week Sir Robert Peel, Gladstonian candidate for Brighton, received a deputation representing local telegraph operators, with regard to a grievance under which all telegraph operators in the United Kingdon labour with regard to Sunday duty. The deputation was headed by Mr. Chapman, who said that they represented 5,000 telegraphists in the provinces, who were formed into an association for the purpose of getting paid for Sunday labour, as their colleagues in London were. He wanted to know whether Sir Robert would support Mr. Bradlaugh's Bill for bringing about that object. Sir Robert Peel said the demand of the provincial operators was perfectly just and reasonable. Should he be returned, he would certainly support Mr. Bradlaugh's Bill.

Personal.—Mr. A. A. Campbell Swinton is now Messrs. C. A. Parsons' & Co.'s London representative for the supply of all their manufactures. Messrs. Parsons will remove into their extensive new works at Heaton, Newcastle-on-Tyne, on the 10th November.

High Speed.—We take the following from the American *Modern Light and Heat*:—"A Southern paper says that the rate of 120 miles per hour was attained at Tacoma, Wash., recently by an electric street car. This must have been another case of 'Electricity on the Rampage.'"

Filey.—Last Tuesday week, at a special meeting of the Local Board, an address was given by Mr. F. Guy, M.I.E.E., on the lighting of the town by electricity.

The Electrical Trades.—A meeting of the Electrical Trades Section Committee of the London Chamber of Commerce will he held on Monday next, the 28th inst., at 4 p.m. Members of the section attending (who are not members of the committee) will be free to participate in the discussions, but not to vote. Agenda:—1. To receive the correspondent's report. 2. To receive result of circular on B.A. screws (specimens of the B.A. screws and screwing tools will be exhibited). 3. To receive result of standardising laboratory circular. 4. To consider the instructions of the County Council to their surveyors, and their action in prohibiting their dispensing powers under the Metropolitan Building Act. 5. Commercial education scheme, scholarships and prizes. 6. Report of railway rates question up to date. 7. Fraudulent bills of lading, letters from Sydney Chamber of Commerce and Institute of London Underwriters; Dufferin banquet; trade reports and statistics.

The Consul in London for Chili has courteously replied as below (for the information of the Electrical and Allied Trades Section) to an enquiry made by the Secretary of the London Chamber of Commerce:—"I should say that electrical machinery and electric lighting apparatus imported into Chili would come under the general head of machinery, and be subject to an *ad valorem* duty of 15 per cent. Motors of any class, and such like, have a fixed valuation of 25 cents. per kilo. The exchange is adjusted periodically. The latest tariff I have is dated 1888, but should the interested parties to whom you refer wish to consult it, I shall be happy to allow them to do so at this office (Chilian Consulate, 50, Old Broad Street, E.C.)—(Signed) ARTHUR G. KENDALL. October 21st, 1889."

Electric Lighting of Asylums.—The Royal Lunatic Asylum at Gartnavel, near Glasgow, is about to be lighted by electricity, the specification having been drawn out and the contract settled by Mr. William A. Bryson, consulting electrical engineer, of Glasgow. The installation will consist of one No. 5 Manchester dynamo for 400 incandescent lights, and one No. 3 dynamo for charging accumulators for 50 lights to be used as a pilot circuit at night. The total number of lamps will be 370 of 16 C.P., and six large sunbeam lamps of 200 C.P. each. Messrs. Anderson and Munro are the contractors for the work, which will be carried out under Mr. W. A. Bryson's supervision.

Bakery Lighting.—Messrs. Stevenson's Battersea Bakeries are well lighted by the electric light.

London Tramways Company.—It is the intention of this company not only to drive Jarman's cars, but to light houses from its depôt by electricity.

Kensington Central Electric Lighting Station.—On Tuesday night a meeting of the *employés* and students of the House-to-House Electric Light Company, Limited, was held at the Courtfield Hotel (lighted by the company) for the purpose of presenting Mr. J. W. Chisholm, engineer in charge, who is leaving Kensington to superintend the erection of a similar central station to that at Kensington, in Madrid, with a token of their appreciation and esteem. Mr. Bavor was elected to the chair, and made the presentation, which consisted of a handsome gold albert, after which a very pleasant evening was spent. A meerschaum pipe was presented to another member of the staff, who is leaving to assist Mr. Chisholm. This expression of feeling indicates the unanimity and harmony with which the work is carried on at these works, and is in some measure accountable for the very successful running of the installation.

Electric Lighting at Cork.—Last Friday a long report was submitted to the Corporation. The report recommends the work being done by the Irish House-to-House Electricity Company, which could carry out the lighting cheaper than could be done by the Corporation. The matter was postponed for a week.

Obituary.—We regret to announce the death of Viscount Torrington, the chairman of Messrs. Crompton and Company, Limited, which took place on Sunday, 20th inst., at Dinard, in France, where he had gone for the benefit of his health. Viscount Torrington was also chairman of the Crompton Electric Light Company, of Australia. He was most enthusiastic in the cause of electric lighting, and there is not the slightest doubt that overwork hurried him to his end. His loss will be deplored by all who knew him.

The Northampton Electric Light and Power Company.—A meeting of this company was held last week to consider the course to be pursued, the shares not having been applied for in sufficient numbers to permit the carrying out of the original scheme. After discussion, the founders declared themselves willing to forego certain advantages which would enable the company to commence work. It was subsequently announced that 3,300 additional shares had been applied for during the meeting, and further applications are being received.

Mechanical Telephones.—An attempt is about to be made in Glasgow to introduce a new telephone, styled "The Pulsion." The telephone is a purely mechanical one, and is exceedingly simple in construction. As yet the pulsion telephone is still in its infantile stage of development. It has only been worked to a length of six miles, and for the present it is intended to introduce it in Glasgow privately and for short distances. The pulsion telephone has been at work in the United States for several months, and is stated to be much cheaper than other telephonic systems. Surely this is an old friend from the other side under a new name? Various attempts have been made during the past few years to introduce mechanical telephones into this country, but hitherto they have only met with "repulsion."

NEW COMPANY REGISTERED.

Birmingham Safe Deposit Company, Limited.—Capital £20,000 in £5 shares. To carry on the business of a safe deposit company, and in conjunction therewith the business of gas, electrical and mechanical engineers. Signatories (with 1 share each): C. J. Lee, 84, Lombard Street; S. H. Lee, 84, Lombard Street; H. R. Bulson, 65, St. Thomas Road, Finsbury Park; T. V. A. Bracher, 81, Ashburnham Grove, Greenwich; H. W. Miles, 60, Drayton Park, Highbury; C. H. Sellick, 26, Disraeli Road, Forest Gate; A. Sheffield, 12, George Yard, Lombard Street. Registered 18th inst., without special articles of association, by Herbert F. Oddy, 58, Lombard Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Taunton Delmard Lane and Company, Limited (mechanical, electrical, and scientific engineers).—The statutory return of this company, made up to the 13th June, was filed on the 12th August. The nominal capital is £125,000, in £10 shares, divided into 3,000 preference and 9,500 ordinary shares; the whole of the former and 6,746 of the latter are taken up. Upon the preference shares the full amount has been called, and £7 10s. has been called upon the ordinary shares. 1,349 fully paid preference shares and 2,750 ordinary shares, fully paid up, and 2,480 ordinary shares with £7 10s. paid up were issued to the vendors as part payment of the purchase money. The calls paid amount to £27,102 10s., and £187 10s. has been paid in advance of calls. The calls unpaid amount to £777 10s. Registered office, the Star Works, Heneage Street, Birmingham.

Electrical Accessories Company, Limited.—An agreement of 10th inst., filed on the 17th inst., provides for the purchase by this company from Mrs. S. Atkins, of 172, Horkley Hill, Birmingham, the lease of 172, Horkley Hill, the goodwill of the business carried on there, together with patents, goods, stock in trade, machinery, &c., for £1,500 in fully paid shares. Registered office, 66, Victoria Street, S.W.

Electricity Supply Company for Spain, Limited.—An agreement of 6th June, filed 17th inst., between P. A. Latham and Robert Hammond, provides for the issue to the latter of 100 fully paid founders' shares in consideration of his defraying all costs of the formation and registration of the company. An agreement of 4th inst., registered 17th inst., confirms the above.

Electric Construction Corporation, Limited.—The statutory return of this company, made up to the 12th inst., was filed on the 17th inst. The nominal capital is £500,000, divided into 100 founders' and 49,900 ordinary shares of £10 each, the whole of which are taken up. Upon the founders' shares the full amount has been called up, and £6 per share has been called upon 45,000 ordinary shares; 4,900 shares are considered as fully paid. The calls paid amount to £45,286. Registered office, Worcester House, Walbrook, E.C.

Woodhouse and Rawson Electric Contract and Maintenance Company, Limited.—The annual return of this company, made up to the 1st inst., was filed on the 16th inst. The nominal capital is £50,000, in £10 shares, 1,008 shares are taken up, and of these 505 are considered as fully paid. Upon 503 shares £4 per share has been called, the calls paid amounting to £2,008, and unpaid to £4.

At general meetings of the company, held on the 17th ult. and 1st inst., the following special resolution was duly passed and confirmed:—"That the company be wound up voluntarily under the provisions of the Companies' Act, 1862 and 1867; and that Mr. Gustavus Adolphus Steinthal, late of 35, North Parade, and now of 41, Piccadilly, Bradford, be, and is hereby appointed, liquidator for the purpose of such winding up." This resolution was duly filed on the 18th inst.

Laing, Wharton and Down Construction Syndicate, Limited.—The statutory return of this company is made up to the 3rd July. The nominal capital is £40,000 in £100 shares, 300 shares are taken up, 100 being considered as fully paid. Upon the remaining 200 shares the full amount has been called, the calls paid amounting to £10,400, and unpaid to £9,600. Registered office, 82A, New Broad Street.

Bath Electric Light Company, Limited.—The statutory return of this company, made up to the 23rd July, was filed on the 2nd August. The nominal capital is £25,000 in £10 shares. At the date of the return only 7 shares were taken up, and upon these £2 per share had been called, the calls paid amounting to £7, and unpaid to £7. Registered office, 2, Northumberland Buildings, Bath.

Nottingham Electric Light and Power Company, Limited.—The statutory return of this company, made up to the 6th July, was filed 11th July. The nominal capital is £100,000, divided into 9,900 ordinary and 100 founders' shares of £10 each. The shares taken up are 200 ordinary and 27 founders', but at the date of the return no call had been made thereon. Registered office, 22, Low Pavement, Nottingham.

Priestman Brothers, Limited (mechanical and electrical engineers).—The statutory return of this company, made up to the 18th July, was filed on the 23rd July. The nominal capital is £150,000, divided into 3,000 preference and 12,000 ordinary shares of £10 each. The shares taken up are 3,000 preference and 8,783 ordinary. The full amount is considered as paid upon these shares. Registered office, Holderness Foundry, Kingston-upon-Hull.

Maxim-Weston Electric Company, Limited.—The statutory return of this company, made up to the 30th

May, was filed on the 29th July. The nominal capital is £75,000, divided into 500,000 shares of 3s. each. 261,886 shares have been taken up, and 6d. per share has been called thereupon. The sum of £26,188 12s. is considered as paid up. The calls paid amount to £6,433 0s. 6d., and unpaid to £114 2s. 6d. Registered office, 55, Victoria Street, S.W.

CITY NOTES, REPORTS, MEETINGS, &c.

The Eastern Extension, Australasia, and China Telegraph Company, Limited.

THE thirty-second ordinary general meeting was held on Wednesday last at Winchester House, Sir John Pender presiding.

The Secretary having read the notice and the minutes of the last meeting,

The Chairman said: You have had the report in your hands for some days, and, I presume, will take it as read. Before asking for your approval, I shall, as usual, make a few remarks upon the working of our system during the last six months. The gross receipts for the half-year amounted to £256,757, against £239,926 for the corresponding period of 1888, showing an increase of £16,831, which is due to the general growth of business all over our system. The working expenses have been £73,773, against £69,297 for the corresponding period, showing an increase of £4,476. This increase is caused by the opening of a coast station in connection with the Western Australian cable, and the construction of a new pipe line of about a mile and a quarter, costing £1,364 to replace the one which had been down for about ten years. The net revenue amounted to £138,736 against £125,804 for the corresponding period of 1888, showing an increase of £12,932. Interim dividends, at the rate of 5 per cent. per annum, have been paid for the half-year, leaving £26,000 to be carried forward, after debiting revenue, £50,000 on account of the Western Australian cable. It will be in your recollection that after our two cables were interrupted to Australia we decided, without any delay, to put down an additional cable so as to give us perfect security and continuity in the connection with our colonies: that cost a large sum of money, but it did not bring us any additional traffic, it was practically a reserve, and since that cable was laid we have good reason to congratulate ourselves in having laid it at the time we did, because there has been certain interruptions in land lines in Australia extending for some time, which, if this line had not been laid, would have interrupted the traffic. We therefore thought—although there was to be practically no revenue from it, though it maintains our revenue—it a wise thing to pay it off as quickly as possible, and pay it out of revenue. It has been our policy, as you are aware, to keep down capital as much as possible. We have taken very broad views of this business, and paid off £50,000 of the cost of that cable; still, we are enabled to maintain our dividends as before, and carry forward a considerable sum to the balance cost. We have also, since this half-year began, had important interruptions in the New Zealand cable, which extended for some considerable period of time—12 or 14 days. That so interfered with the traffic betwixt New Zealand and Australia, that we determined, without any delay, to lay down a duplicate cable. We felt that the work of that cable was increasing, and also that it had been down for 14 years, and that the time must soon come for duplication, and we thought the sooner the better. We have, therefore, communicated with the New Zealand Government on the subject. This is not any too soon, because the last news we had from New Zealand, we find that the people were so dissatisfied with the interruption that had taken place, and so inconvenienced by it, that they were appealing to the Government to give them a duplicate line. I was rather pleased that they should have felt a little inconvenience, because when I look back a couple of years, when we were fighting the New Zealand Government for our rights, I think we practically gained what we desired to have; still, our business is to maintain our system in as able and as efficient a manner as to make it almost impossible for any one to come into the field against us. We have without delay sent a telegram to the New Zealand Government proposing duplication upon certain considerations, and I am hopeful that before a week passes over our heads we shall be in a position to go on with the duplication of the New Zealand system. I think it is well that you should understand that is the policy which we have found to work well. Though this duplicated cable will not bring us an additional income it will secure to us the income which we are already earning, and which we are glad to say is accruing. I am pleased to tell you to-day that all our cables are in good working order; we have got something like thirteen thousand miles of cable in the bottom of the sea. I have just told you that the Western Australian cable was not laid a minute too soon; and I have told you the New Zealand cable was interrupted, and the sooner it is duplicated the better. In connection with the New Zealand I may remark, as I think it is our business to give our shareholders as clear a view of our policy as it is possible under the circumstances in which we are acting. You have heard a great deal about a Pacific line—an opposition line—the object being more to reduce our rates than to give increased facilities. Our present line is equal to a great deal more work than we can pass over it, but if the Government of our colonies and our own Government determine for strategical purposes, that a Pacific cable should be laid, I may tell you that we are quite prepared; not that it will bring any additional traffic to us, but we feel that our system is so important for commercial as well as political requirements that it will be our duty to do it, and we are quite prepared to do the work, if we are fairly and properly remunerated for it. This line to New Zealand which we propose to duplicate will be what you may call the first link in a Pacific system. There are other islands adjoining Fiji which have lately been acquired; in short, there may be, and I believe there will be, some day, a line laid from New Zealand to Vancouver, from thence over the Atlantic lines to England, but it will not be laid for commercial purposes, but for strategical purposes, and as you know if war breaks out and if Government required anything in the way of ships, they are always prepared to pay for the use of the telegraph, and we shall be quite prepared to deal with the matter. Our company occupies a restless position; we can never sit quietly down; we must meet every requirement as it comes up to maintain the position we now occupy. There is a great deal of work before us, and it is the duty of the directors to do that work with due regard to the interests of the shareholders. The question of debentures, which expire in 1891, will be dealt with in the best possible manner when the time comes. I congratulate you to-day upon the sound position which we occupy. Everything is in efficient working, and taking all together I hope you will approve of our policy.

After remarks from one or two shareholders the report was adopted.

Montevideo Company.

A GENERAL meeting of this company was held last Friday at the office of the company, Abchurch Lane, Mr. A. Holland in the chair, who said as regarded the profits of £10,000, they considered it extremely satisfactory, because in the first place it was a new company, they had to contend against the usual dislocation and interruptions which took place when a business was transferred from one set of managers to another, and in addition they had suffered very severely in February last from a cyclone which uprooted posts and damaged wires to a very considerable extent, but thanks to the able management over there matters were soon put right. Comparing expenses with those of other telephonic enterprises they found they only amounted to 40 per cent. as against 50 per cent. which was, considering the state of affairs when they first took over the concern very satisfactory. As mentioned in the report a small sum had been written off for preliminary expenses and furniture, which would be entirely wiped out in a few years. The balance of £10,000 they proposed to devote to a dividend of 6 per cent. on the deferred shares, to place £1,000 to renewal account which was, he thought, a prudent measure, considering the nature of the undertaking. A dividend of 2½ per cent. was proposed on the ordinary capital, and £3,000 which remained after the payment of the 6 per cent. was almost sufficient for a 5 per cent. dividend, but they deemed it best to limit it to 2½. The chief point to call attention to was the amalgamation with the company known as the Gower-Bell. The board considered this expedient, as it not only consolidated their position but would stop any other companies from getting a footing there. The number of subscribers gained by the amalgamation was very disappointing, for they found a considerable number were duplicates of their own subscribers, and therefore ceased the Gower-Bell's subscription, a considerable number were bad payers which he considered very undesirable. In order to still further perfect the telephonic system they had adopted under the direction of their managers, the Messrs. Parrs, the multiple switchboard which would entirely obviate the annoying waits which subscribers experienced under the old system; the cost of the switchboard amounted to something like £5,000, and they had made arrangements to increase the capital to meet that expenditure. Judging from the experience of those who were using the multiple switchboard subscribers would doubtless increase rapidly.

The report was unanimously adopted.

A vote of thanks to the chairman concluded the proceedings.

The Consolidated Telephone Construction and Maintenance Company, Limited.—The directors, at their board meeting held last week, resolved to declare an interim dividend for the half-year at the rate of £5 per cent. per annum, less income tax, on the ordinary shares, and at the rate of £6 per cent. per annum, less income tax, on the preference shares. The respective dividends to be payable on and and after the 14th November next. The transfer books to be closed from the 25th to the 28th inst., both days inclusive.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The traffic receipts for the week ending October 18th, 1889, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company Limited, were £2,990.

CONTRIBUTIONS TO THE CHEMISTRY OF STORAGE BATTERIES. No. 2.*

By E. FRANKLAND, D.C.L., F.R.S.

UNDER this title I communicated to the Royal Society, in February, 1883,† the results of some experiments on the reactions occurring during the charging and discharging of a storage cell. I showed that no appreciable part of the storage effect was due to occluded gases, as had been previously suggested by some chemists and physicists; but that the act of charging consisted essentially in the decomposition of lead sulphate, whilst the discharge was produced by the recomposition of this salt.

The establishment of these, as practically the only reactions going on in a storage cell, enabled me to prescribe a very simple method by which the charge in any cell could be ascertained; for as sulphuric acid is liberated during the charging and absorbed by the active material of the plates during discharge, the amount of charge could at any time be measured by ascertaining the amount of free sulphuric acid in the cell; in other words, by simply determining the specific gravity of the electrolyte; and this method has since been very generally adopted by the users of storage batteries.

In continuing these experiments, it soon became evident that the lead sulphate formed and decomposed in the cell could not be the ordinary white sulphate hitherto known to chemists, because, in the first place, the active material of the plates always remains coloured even after discharge, and secondly, because whenever white sulphate is produced through abnormal reactions in the cell, it is afterwards decomposed only with extreme difficulty by the electric current.

In order to obtain some light upon the composition of the sulphate formed and decomposed in the cell, I have studied the action of dilute sulphuric acid upon litharge and minium, the two oxides of lead chiefly used in the construction of the plates of storage cells.

Action of Dilute Sulphuric Acid on Litharge.

Finely powdered litharge was treated with successive portions of dilute sulphuric acid until the liquid remained strongly acid after prolonged trituration. The resulting insoluble buff-coloured powder was washed with water till free from acid, and dried, first at 100° C. and afterwards at 150—160°. The loss at this higher temperature was less than 0·2 per cent., and was therefore due to hygroscopic moisture.

PbO and SO_3 were then determined in the dried compound as follows:—The salt was dissolved in a small quantity of pure concentrated solution of caustic potash, and the solution, after dilution, was saturated with CO_2. (According to H. Rose, COPbo″ is soluble in $COKo_2$, but not in COHoKo.) Any excess of CO_2, which might have caused the COPbo″ to dissolve, was avoided by warming the liquid with the precipitate on the water bath to a temperature at which the COHoKo begins to dissociate. The liquid was then allowed to cool and to stand twelve hours before filtering. The COPbo″ was filtered off, converted into nitrate, and precipitated and weighed as sulphate. The sulphuric acid was determined in the filtrate from the COPbo″.

1·2964 grams of the salt gave 0·6647 gram baric sulphate and 1·4437 gram plumbic sulphate.

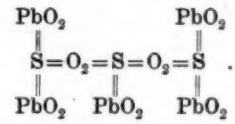
These numbers agree closely with the formula—

$$(SO_3)_3(PbO)_5,$$

as is seen from the following comparison of calculated and experimental numbers:—

	Calculated.		Found.
$3SO_3$	240	17·71	17·61
$5PbO$	1115	82·29	81·96
	1355	100·00	99·57

These analytical results suggest the following graphic formula:—



The formation of this salt may be represented by the following equation:—

$$5PbO + 3SO_4H_2 = S_3Pb_5O_{14} + 3OH_2.$$

Litharge. Sulphuric acid. Buff lead salt. Water.

Action of Dilute Sulphuric Acid on Minium.

Minium was treated with dilute sulphuric acid in exactly the same way as litharge, and the resulting brownish red compound dried first at 100° C., and afterwards at 150°—160°. The loss at this higher temperature was again less than 0·2 per cent.

PbO, SO_3, and excess of oxygen were then determined in this salt in the following manner:—The salt was first treated with concentrated hydrochloric acid in order to reduce all the lead to the monoxide stage. The resulting mixture was then dissolved in caustic potash and treated as already described. The excess of oxygen was determined by finding the loss of weight which resulted from the evolution of CO_2 when the salt was treated with oxalic acid and dilute nitric acid.

2·1136 grams of the salt gave 1·1978 grams baric sulphate and 2·2710 grams lead sulphate.

1·5110 gram treated with oxalic acid and dilute nitric acid evolved 0·0910 gram CO_2.

These numbers correspond to the following percentages:—

SO_3	19·46
PbO	79·08
O	1·09
	99·63

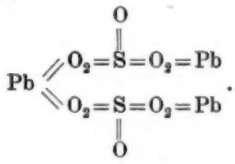
which agree with the formula—

$$S_2Pb_3O_{10},$$

as is seen from the following comparison:—

	Calculated.		Found.
S_2	64	7·57	7·78
Pb_3	621	73·49	73·41
O_{10}	160	18·94	18·44
	845	100·00	99·63

The composition of this salt may be represented graphically thus:—



The formation of this salt is expressed by the following equation:—

$$Pb_3O_4 + 2SO_4H_2 = S_2Pb_3O_{10} + 2OH_2.$$

Minium. Sulphuric acid. Red lead salt. Water.

These then are the salts which constitute the original active material of storage cells when that material is formed by the admixture of sulphuric acid with litharge or minium respectively, and it is highly probable that one or the other of these salts takes part in the electrolytic processes of the storage battery. It is fortunate that these hitherto unknown salts (and not the ordinary known sulphate) are formed in the cell reactions; for, in the alternative case, lead storage batteries would be practically valueless.

If the buff lead salt be the active material of the battery plates, then the following equations express the electrolytic reactions taking place in the cell:—

* From the "Proceedings of the Royal Society," vol. 46.
† "Proceedings of the Royal Society," vol. 35, p. 67.

I. In charging—

(a.) Positive Plates.

$$\underset{\text{Buff lead salt.}}{S_3Pb_5O_{14}} + 3\underset{\text{Water.}}{OH_2} + O_5 = 5\underset{\text{Lead peroxide.*}}{PbO_2} + 3\underset{\text{Sulphuric acid.}}{SO_4H_2}.$$

(b.) Negative Plates.

$$S_3Pb_5O_{14} + 5H_2 = 5Pb + 3SO_4H_2 + 2OH_2.$$

II. In discharging—

(a.) Positive Plates.

$$5PbO_2 + 3SO_4H_2 + 5H_2 = S_3Pb_5O_{14} + 8OH_2.$$

(b.) Negative Plates.

$$5Pb + 3SO_4H_2 + O_5 = S_3Pb_5O_{14} + 3OH_2.$$

If the red lead salt be the active material, then the following equations express the same electrolytic reactions:—

I. In charging—

(a.) Positive Plates.

$$\underset{\text{Red lead salt.}}{S_2Pb_3O_{10}} + O_2 + 2OH_2 = 3\underset{\text{Lead peroxide.}}{PbO_2} + 2\underset{\text{Sulphuric acid.}}{SO_4H_2}.$$

(b.) Negative Plates.

$$S_2Pb_3O_{10} + 4H_2 = 3Pb + 2SO_4H_2 + 2OH_2.$$

II. In discharging—

(a.) Positive Plates.

$$3PbO_2 + 2SO_4H_2 + 2H_2 = S_2Pb_3O_{10} + 4OH_2.$$

(b.) Negative Plates.

$$3Pb + 2SO_4H_2 + 2O_2 = S_2Pb_3O_{10} + 2OH_2.$$

An inspection of these equations discloses, in the case of the red lead salt, a fact which has already been roughly observed in practice, viz., that only half as much active material is electrolytically decomposed on the negative as on the positive plates; whence it follows that the weight of active material on the negative plates need not exceed one-half of that upon the positive plates; for, in the decomposition of the electrolyte, equivalent quantities of oxygen and hydrogen are evolved; that is to say, two atoms of hydrogen for each atom of oxygen. But, in the decomposition of the red lead salt, four times as many atoms of hydrogen are required to reduce the salt to metallic lead as atoms of oxygen which are necessary to transform the lead of the salt into peroxide. When, however, the active material of the positive plate has once been converted into peroxide of lead, it seems probable that the red salt only is formed; at all events until the discharge at high potential is nearly completed, when there are indications of the production of the buff-coloured salt. But this is a point requiring further investigation.

I have to thank Dr. F. R. Japp, F.R.S., for his assistance in the analytical work of this investigation.

THE BOSTON WEST END STREET RAILWAYS.

PRESIDENT H. M. WHITNEY'S OPINIONS.

AT a meeting of the stockholders of the West End Railway Company, of Boston, on July 25th, 1889, called for the purpose of taking action in reference to an increase in the capital stock of the company, a very interesting address was made to the stockholders by President Henry M. Whitney, which, says the *Electrical Engineer* of New York, it has been our intention to print in full, but owing to the pressure upon our space, we must ask our readers to content themselves with an abstract of its most important points.

President Whitney referred to a statement made at the last meeting in reference to certain routes which were being equipped by the company for the purpose of testing the system of electric traction, and said that since that time these routes had been put in operation. They had not only met the highest expectations of the company, but had more than fulfilled the hopes of the community. So far as he was aware, the sentiment throughout the section covered by the electric road was entirely unanimous; every community reached by it was extremely anxious for the extension of the electric service. On July 6th the electric line from Havard Square to Arlington was opened, and the very quickest time it had ever before been possible to make—35 minutes—had now been reduced to 20 minutes schedule time. The company now came before the stockholders and the community in this position:—The community are satisfied that the system will accommodate the people, while it was so much cheaper in its operation that it was advisable for the company to put it in at the earliest possible day. Moreover, the company finding how communities are interlocked with each other, found itself absolutely compelled to take the system up wholesale; in making the change from horses to electricity, it was necessary to include the whole system.

The electrical centre of Boston inside of Charles River was at Pleasant Street and Shawmut Avenue. As the travel increased to the Highland district, the electrical centre will in a short time be almost coincident with the Hinckley Locomotive Works property, which the company had recently purchased for a power station. For twenty-five years to come every electric car inside of Charles River, including South Boston, could be economically run from that station.

The operation of the cars would involve at no distant day the furnishing of 10,000 H.P., costing in a large plant about $100 per H.P. A good double motor cost $3,000 and a single motor $2,000. They were running to-day between 700 and 800 cars, and if the experience since electric cars were introduced is any criterion, they should not only want those but an immense number more immediately. Then there was wire and poles, new construction, new equipment, new track, &c., which all went to make up the four millions and a half of new stock which must be issued to make this change. Few of the stockholders realised the actual situation of the company, whether the change be made or not. The present investment, made up of road, rails, cars, horses and equipments represent $11,619,172. The steady regular increase was 10 per cent.; but if the service is increased 10 per cent., the number of horses and cars, value of real estate and general equipment must be increased in the same proportion. The West End company did not own a single car, horse, or foot of track in excess of its needs. So much for the increase with horses; but what were the facts as to electric roads? The Arlington line had been in operation 17 days. For the same time last year the receipts were $2,721; the receipts for this year were $6,273—absolutely 150 per cent. increase for every single day of running. Now look at the Brighton line. The total receipts for June last year, $4,426; for June this year, $8,759. There are the number of people to be provided for. The directors have no knowledge how large this increase of travel will be with electric cars, but they have seen enough to know that it will largely exceed all experience. There are, perhaps, 50 or 75 miles where it would be best to put in new rails. For example, the time from Arlington to Harvard Square, four miles, is 20 minutes, 12 miles per hour; the average rate of speed of elevated roads in New York is only 10·89 miles per hour. *The West End electric cars are now making in the City of Cambridge a rate of speed absolutely one-eighth more than the elevated trains in New York.* This showing had entirely changed the sentiments of the people of Cambridge, who had been so strongly in favour of an elevated road. The West End company ultimately expected to make 15 miles an hour; they could certainly reduce the time very materially, and utterly dispose of the question of an elevated road. The company had 776 cars standing on its books, at a little less than $1,000 per car, which were as good as new. It need not cost $100 apiece to turn them into electric cars, so it was of little consequence whether they used the old cars or bought new ones. There

* Mr. Fitzgerald considers that this peroxide is hydrated.

would not be a dollar lost in car equipment in changing from horses to electricity. It was the custom of the company to charge every month to repairs, depreciation on horses, and renewals, 12 per cent. a month; in round numbers $150,000 a year to depreciation in horses. It would be utterly impossible for the company to make the change in haste. It will be made so gradually that the depreciation of horses will only be felt in the accustomed way, as it is now charged from month to month.

Finally, as to the cost of operating. The question that largely concerned the stockholders, especially with reference to increase of stock. The average cost of motive power by horse for the past six months is 10·16 cents a mile, which does not include drivers, conductors, starters, repairers of track, and all such things which is the cost of horse motive power. All the company's experience in the actual operation of the electric road from Allston, with all the disadvantages of pouring power into a leaky conduit and absolutely losing it, with the disadvantages of operating from a remote point, the cost of fuel required is only 1½ cents per car mile. The directors believe that the cost of power, engineering, engineers, and all other expenses have been paid at a trifle over 3 cents per car mile. The cost of engineers and so on is large in proportion, because the mileage is small. The directors believe that the cost of power, operating, engineers, and every expense at the power house would not exceed 2½ cents per mile, and the engineers predicted it would be very much less. The estimated cost of taking care of the motors and of the overhead line would not exceed 2½ cents per mile more. There was a clear saving of 5 cents a mile, to say nothing of the further saving in the cost of operation of the road due to increased speed, which anybody could figure for himself, and which was a very important feature.

What did all this mean? It meant that with the electric system the West End company could give the community all it needed in the way of rapid transit, greater accommodations, more frequent trips. All those things took money; but if the company were to go forward and fulfil the expectations of the community, and justify the trust placed in it in reference to the transportation of passengers, a trust that concerned the 300,000 people that crowded their cars daily, the directors must be placed in a position to get the money to do this work.

At the close of Mr. Whitney's address, Mr. Hyde moved that the directors be authorised to petition for leave to increase the capital of the company to the amount of $4,500,000, which was agreed to and passed.

ELECTRIC LIGHTING IN THE CITY.

IMPORTANT DEBATE.

BOILERS, STEAM ENGINES AND DYNAMOS UNNECESSARY.

THE City Commissioners of Sewers last Tuesday held a special court (Mr. G. Manners in the chair) to discuss the report of the Electric Lighting Committee. The Chairman having formally moved that the report be agreed with,

Mr. SLY opened the debate and expressed himself as satisfied at the length of time which had been given to members to study the report. Previously he had opposed the recommendations of the committee, and he was not at all sorry for having done so because there were now more companies in the field than then; besides which, the members had had an opportunity of going into the matter under better auspices than they could have done previously. The court now had to meet certain arrangements which had been made through the officers of the Crown, for they had to consider the report by the Board of Trade. Major Marindin told them that in regard to electric lighting in the City, "The Commissioners of Sewers, acting for the Corporation, are endeavouring to obtain tenders for the lighting of the City, but I see no reason why the principle that all such lighting should be done under statutory powers and obligations, should be departed from in their case." That seemed to put them in rather a difficult position, and one different from what they were in before. They did not want to have to fight the provisional orders, but to do the best they could for the people in the City. He was gratified to notice that Mr. Preece in his report had criticised Major Marindin's report and said: "The chief point that he has neglected is the £ s. d. point that the guardians of the public interest have to consider so carefully, viz., that the streets may be illuminated with the best artificial light, obtained at the cheapest possible cost." Mr. Preece also reported: "In some cases it is quite clear that the desire has been to illuminate the City more brilliantly than any other city in the world, and I think in some cases that has been done to excess. My own view is that one arc lamp should, on the average, replace four gas lamps, and that the normal arc lamp should not cost the City more than £26 per annum." All those, Mr. Sly thought, were important elements to be considered from a ratepayer's point of view. He opposed the report because he thought it was possible to make better and cheaper arrangements by waiting a little while. It was not so much a question of obtaining electric light, as of making certain of its success when adopted. They ought to consider the matter in the interests of the ratepayers, but he found that the committee reported "that to light the main thoroughfares of the City by means of 395 arc lamps, would cost £10,024, in place of 1,736 gas lamps now costing £5,530 per annum." But they finished the report—he would not say artfully, but rather cleverly, as they said, "whilst the price will not be double that of gas, the amount of light will be many times greater." The words "many times," might mean ten, five, or six times greater, but they were not informed what amount of light there would really be, and therefore, to a certain extent, they were unable to consider what would be the cost of the light for which they would have to pay. If the light was to be ten times that of gas, or even six times, they did not want such a light as that; in fact, he thought they scarcely wanted three times, or even twice the light of gas. The House-to-House Company stated that they could provide arc lamps of 1,000 candle-power and 280 watts for £25 per annum. Then, if it was a question of degree, why could they not supply 500 candle-power and so many watts at about half the price? If that could be done, they would then get their light at the same cost that they were now paying for gas, and everyone would be satisfied. The report in one of the specifications stated: "So soon as the main thoroughfares in the district have been lighted by electricity, the contractor must proceed to light the remainder of the public ways when called upon to do so by the Commission." But the court were not informed what the result of that would be nor what would be the cost. If what was proposed to be done would cost them about £11,000, the addition of other thoroughfares might bring it up to double. Whatever it was, they ought to have some idea given them. They should understand what they were going to pay as the result of agreeing with the report of the committee. Another point was, that of necessity there would be a certain amount of cost in connection with the pulling up of the streets and other work, which might lead to arbitration, which was a costly proceeding. Altogether, he considered the cost to the City would be very much more than double the price of gas. He had not heard from those who usually attended the bar of the court that there had been a very strong opinion in favour of having the electric light. Certainly there were some who thought they ought not to be behind other places, but he submitted that they were not behind. In whatever arrangements they made, they ought to be careful to get a good light and to get it as cheaply as they could.

Mr. MCCARTHY objected to the report and took exception to the Commission granting to the contractor the exclusive right of supplying electricity for private purposes within the district during the term of the contract. He also thought it would cost the citizens about twice the amount of money they paid for gas. Moreover, the restriction was placed upon them that they should not have any other electric light than that supplied by the contracting company. It was not necessary that they should have electric light throughout the City, and he thought it would be sufficient if the main thoroughfares were lighted. Then again, the light would not be required for more than about 8½ hours, as nearly all the citizens were out of the City at night. They were going to be put to great expense, which, in his opinion, need not be incurred.

Mr. PANNELL moved, as an amendment, that the report be referred back to the Committee for re-consideration. At some length this speaker drew attention to the fact that the London Electric Supply Corporation had made objections and had only agreed provisionally to a number of the requirements of the committee. He thought it was a serious matter that, in regard to the question of the division of profits, the London Electric Supply Corporation stated expressly that they were "unable to agree with any portion of the clause." The clause was, "that if the profits arising from the contract exceed an accumulative dividend of 10 per cent. per annum upon the capital invested, the excess is to be divided equally between the contractor and the consumer. In other words the contractor will not be entitled to pay a dividend of over 10 per cent. per annum, calculated from the commencement of the contract, unless at the same time the cost of the supply of the electricity to the consumer is reduced at the rate of one halfpenny per unit as per schedule, for each one per cent. added to the dividend." That clause was the *sine qua non* of their report, and the Corporation objected to it entirely.

Mr. ALDERMAN MOORE seconded the amendment.

Mr. A. H. BRIDGMAN pointed out that Major Marindin thus reported as to the lighting of the City:—"I see no reason why the principle that all lighting should be done under statutory powers and obligations should be departed from in their case," and that therefore the City authorities would have to be in accord with those obligations. That was one reason why the report should go back to the committee. Another reason was, they were

advancing in this question of electric lighting, and it would be quite possible shortly to light the City by electricity at the same price as they were charged for gas. The committee were in favour of deputing the lighting to three companies, but the price they would charge would be twice that now paid for gas. It was a fact which he had seen demonstrated on Friday last, that electric light could be produced without any steam power or machinery whatever. Batteries of alternating plates of copper in sulphuric acid, water and carbon plates in baths of nitric acid, generated electricity, and it was conveyed to secondary batteries for distribution. Boilers and steam engines, and dynamos were entirely dispensed with. After a few days' or weeks' demonstrations it would probably be shown that they could obtain electric light at the same price as they were now paying for gas. The report then should go back not only to have other conditions attached to the contractors tenders, but to receive further tenders or proposals which would be submitted to them.

Mr. C. T. HARRIS remarked that the committee had failed to obtain the terms settled upon by the Commission who were now recommended to accept tenders on totally different lines, and some of the most vital safeguards provided by the Commission had been swept away. He would like to know whether it was intended to contract with the companies outside the statutory obligations. Two of the companies would not undertake the contracts unless they obtained statutory powers, but the Anglo-American Brush Corporation were anxious to get to work without such powers. There was no guarantee that they would get the powers. He would not say that the Brush Corporation was fully qualified for the public and private lighting of the whole of the heart of the City. That company seemed to be ready to consent to anything to get possession of that most important and valuable part of the City. They would give the Corporation the very small boon of a little public lighting in order to get hold of the private lighting which was the chief source of profit. He considered the street was not one-twentieth part of the value of private lighting, and he could quite understand that this company—of which they had had in the past some curious experience—was desirous of obtaining possession of the heart of the City free from statutory obligations. Their knowledge and experience of Father Brush and his numerous children was not altogether satisfactory. He objected to flying in the face of Parliament and the Board of Trade and doing that for which they had no legal power. A great deal had been said about the value of the arc light, but it was a very uncertain light. They had all seen it at the seaside and noted how it changed colour and bobbed about. The public had not studied the subject of electric lighting as they should have done; and they did not all know the difference between the two kinds of light—the arc and the incandescent. The one could not be looked at and had to be put in a globe; but the other—the incandescent—which was used in hotels and theatres, was a beautiful light and was free from many of the disadvantages attending gas. But it was a very costly light. In the course of a further depreciatory account of the arc light, Mr. Harris said it was spotty, patchy, and wasteful, and the intervening spaces between the lamps, he said, were black patches of shadow. In addition to the cost given in the report of the electric light, it would be necessary to have in readiness, side by side with it, for use in case of accident, another illuminating power. That, of course, would greatly increase the estimated cost, and he believed that instead of £10,000 it would be £13,000, against the £5,000 for gas. If they wanted a better light for the streets they might turn their attention to improving the gas burners and means of lighting. Experiments with that object in view were going on in Cheapside, but all the members of the court did not seem to be aware of the fact.

Mr. ROSE INNES did not see how, as men of business, the court could do other than refer the report back to the committee. Whilst he was very desirous of having the electric light in the City as soon as possible, he wanted to get it on as reasonable terms as possible. It was not advisable to agree to the recommendation to give a contract to the London Electric Supply Corporation on the terms they had put in. The fact that they declined to allow any benefit to the consumer under clause 36—when the cumulative dividend exceeded 10 per cent.—was very much against them. Mr. Harris, however, who seemed to take the side of the gas companies, should have read up the early history of gas lighting in the City. It was a fact that the gas went out over and over again, and it was necessary then to have side by side with it, as a handmaid in case of failure, the old oil lamps always ready. In the same way it was desirable in the first attempts at electric lighting to have gas ready in case of the light failing. But that was no argument why they should not have the electric light. Whilst there were advantages on the side of gas, there were also advantages in favour of electricity. For instance, it did not damage the interior of shops and houses, and in that there was economy. Again, the use of electricity for lighting would considerably reduce the very heavy insurance rates. And only the other day he went into a basement which, under ordinary circumstances, would have been a suffocating gas-lit place, of little value except for storage, but which was lighted up with electricity and was used as a hairdresser's saloon. There were hundreds of similar places in the City, the rent of which could be raised from £40 to £50 up to £200 or £300 a year.

Mr. BELL thought that, as Mr. Harris had not denied, when asked the question, that he was a shareholder in a gas company, he therefore did not come to the discussion with quite clean hands.

This expression of opinion elicited considerable dissent, and the withdrawal of the remark was demanded by the court and acceded to by Mr. Bell, who repudiated any personal offence. Subsequently, Mr. Alderman Moore drew attention to the regulation that no person interested in any gas or water or paving company supplying the City, was allowed to take part in a discussion of those questions when before the court. Being directly challenged on the point, Mr. Harris said he was glad of the opportunity of explicitly stating that he was in no way interested in any such gas, water, or paving company.

Mr. DEPUTY WALTER was of opinion that a good reason for waiting before agreeing to the report was given in the statement that a patent had been recently taken out for electric lighting at half the expense at which it was now generated. If, as he believed there was, foundation for the statement of Mr. Bridgman, they ought to send the report back and instruct the committee to make further inquiries. It would not do to commit themselves to the companies for 7, 14, or 21 years, when they appeared to be on the eve of great improvements.

Mr. BEDFORD seemed, however, to think differently, for he said he did not want to keep the City waiting for the electric light until they had found out all the improvements which could be effected in electricity. They would have to wait a very long time, and therefore he was prepared to accept that which they could get, especially as the question had been referred to one of the ablest electricians of the day—Mr. Preece—and to their own engineer.

Mr. WILLIAMSON also was not disposed to brook delay, his opinion being that the time had arrived when the City ought to be electrically illuminated. Still there were some explanations and modifications needed, he said, in the committee's report. The ratepayers would want to know what they were going to get for their money. If it was shown that they were going to obtain a good light, even if it was more costly than gas, they would loyally support the committee. Electric lighting was in a transition state, and they had no right to deal experimentally with a large sum of money of the ratepayers if they were to be handed over to the companies for so long a period as seven years.

After some observations from Mr. MOORE in favour of the amendment so as to give an opportunity to the companies and the committee to make more advantageous arrangements for the ratepayers,

Mr. GEORGE SHAW urged that every encouragement should be given to the companies to carry out the work of electric lighting. Although all the members desired to see the light in the City, the report ought to go back if it was at all likely that they could adopt any system by which the cost would be about the same as that of gas. He believed there was a probability of that, because within the past few weeks the fact had been brought to his notice that in Paris applications were made to consumers of gas by companies who asked to be allowed to furnish those consumers with electric light at the same price as they had been paying for gas. Since then he had heard of a company that was able to supply the light without a dynamo. He had advised them to consult with Mr. Preece as to whether or not it was practical or only a toy; and he believed that was being done. Those were, Mr. Shaw contended, all good reasons for sending the report back.

The court were evidently of the same opinion, for almost unanimously they adopted the amendment of Mr. Pannell.

NEW PATENTS—1889.

15721. "Improvements in electric motors." H. GROSWITH. Dated October 7. (*Complete.*)

15769. "Apparatus for measuring and recording electric currents." Sir W. THOMSON. Dated October 8.

15775. "Improvements in electro-dynamic and dynamo-electric machines." C. F. WINKLER. Dated October 8. (*Complete.*)

15819. "Improvements in devices for connecting the plates of one electric batttery with another battery or batteries, and with a switchboard or transmitting device." W. F. SMITH. Dated October 8. (*Complete.*)

15820. "Improvements in frames for supporting the plates or elements of a secondary or storage battery." W. F. SMITH. Dated October 8. (*Complete.*)

15821. "Improvements in the method of electrolytically reducing plates of metallic salts to a metal state to 'form' the electrodes of secondary or storage batteries." S. C. C. CURRIE. Dated October 8. (*Complete.*)

15840. "A new and improved meter for electric and other purposes, and for the differential actuating movement thereof." F. H. NALDER, H. NALDER, C. W. S. CRAWLEY, and A. SOAMES. Dated October 9.

15936. "Methods and apparatus for cleaning electric lamps." J. ROBSON. Dated October 10.

15958. "A method of and appliances for preventing excessive heating or undue expansion of electric mains or service conductors through excess of electricity, and, if convenient, utilising such excess." F. W. ENGELBACH and E. B. BRIGHT. Dated October 10.

15963. "Improvements in the manufacture of electrodes or plates for electrical purposes." P. SCHOOP. Dated October 10.

15967. "Improvements in insulating supports for overhead electrical conductors." W. C. JOHNSON and S. E. PHILLIPS. Dated October 10.

15974. "Improvements in electric arc lamps." S. P. BLACKMORE. Dated October 10.

16036. "Improvements in galvanic batteries." W. E. IRISH. Dated October 11. (*Complete.*)

16052. "A new or improved electric safety device." C. CUMMINGS. Dated October 12.

16065. "Improvements in electro-motors." P. VON KNOBLOCH. Dated October 12.

16084. "Improvements in electricity meters." E. DE PASS. (Communicated by E. Marès, France.) Dated October 12.

CORRESPONDENCE.

Teachers and Students.

In the ELECTRICAL REVIEW (October 18th), with your characteristic love of fair play, you comment on that part of the presidential address delivered by Prof. Perry before the students of the Junior Engineering Society, where he says: "In that year (1866) Varley, who was Thomson's partner, and others, made independently one of the grandest discoveries of the century, and presently a machine was in use which excited its own field magnets, the type of all dynamos ever since." You say in reference to the passage quoted, "Now Prof. Perry knew perfectly well that the Varley he refers to was the late Cromwell Varley, and that S. A. Varley, who patented the machine which forms the "type of all dynamos ever since," was never a partner of Thomson. Mr. Perry is not the first public speaker who has overshadowed S. A. Varley's work by bringing into the foreground his brilliant brother."

I would point out that this presidential address to students is not the first occasion Prof. Perry has perpetrated what I regard as a "wilful diffusion of error" in respect to myself. In the introduction to "Electricity as Applied to the Service of Man," written and signed by Prof. Perry, a sentence almost identical with that you have commented upon appears.

Why was Thomson's name introduced at all, and the partnership with my late brother referred to? For two reasons I think, the first being that Prof. Perry desired the students to carry away the impression that the Varley he referred to was not myself, and the partnership was mentioned to associate the name of Thomson with an important scientific discovery fairly described as one of the greatest of the century, and which was made in the first instance by myself, and a little later was also independently discovered by Messrs. Siemens and Wheatstone.

Sir William Thomson, I consider, has reasons for saying preserve me from my friends. I would point out another occasion (which does not affect me personally) where Thomson's name is somewhat unhappily mentioned in connection with the name of Varley. In 1860 my brother, the late C. F. Varley, patented the first of the symmetrical influence machines, and this machine came officially under the notice of Sir W. Thomson as an active member of the jury of the 1862 Exhibition, where the machine was exhibited, and as it was of an altogether new type, it came in not unnaturally, for the enthusiastic admiration of Thomson. Five years later Sir William Thomson patented a machine which acted on the same principle as that of my brother's. A discussion on influence machines occurred some few years back, at the Institution of Electrical Engineers, and the following is extracted from a reported speech of Prof. Ayrton, which appears in the published proceedings of that Institution:—"Although Mr. Varley was not only a great friend of Sir W. Thomson, but was practically a partner of his, so little importance had been attached to Varley's patent of 1860 that Thomson *was not even* aware that Varley had done anything in the matter, and *it was quite* to *our* astonishment and Sir William's that we came across Varley's patents."

It is not pleasant to have to write about oneself at any time, but the wilful diffusion of error in respect to (I may say) all the important work I have been permitted to accomplish during the last 30 years is, I believe, quite unique. As an example, a paper read by me before the Society of Arts in 1859, which created attention at the time, and which led to my late brother being offered the post of electrical engineer to the Atlantic Telegraph Company (the offer being accompanied with the assurance that he might name his own salary), was reproduced some years later in a scientific journal, but with both my Christian names altered. On another occasion I had to demonstrate I was myself, which I did by getting certificates from two eminent men in the electrical profession.

You make the remark that, "Prof. Perry is not the first public speaker who has overshadowed S. A. Varley's work," and you might have further added, that he was by no means the worst offender.

If I could afford to disregard the misrepresentations to which I have been subjected it might be amusing; as it is, I have regarded them it with tolerable equanimity. I am thankful to say I am neither dead, crushed, nor am I seriously disheartened, but the effect of this mean unholy conspiracy has been simply disastrous to my fortunes.

Is it not, at least, a curious spectacle that men who have ridden into public notice and position almost wholly on the wave created by a scientific discovery made, in the first instance, by myself; the men who write the electrical books, and teach the students of the country; men who are handsomely endowed, and preside over institutions which, in the space of a very years, have involved the nation in an expenditure of upwards of £300,000; I say, is it not a curious spectacle, that the influence and power such enviable positions confer, should be employed to wilfully diffuse error.

When I reflect on the severe discipline fate would seem to have allotted out to me, I sometimes think of the play where that comic actor, the late Mr. Robson, used to say, "Dumplings for dinner with apples in 'em is all very well, but when it comes to apple dumplings and no apples in 'em, them's hard times." Now, I may truly say of all the work of any real value I have accomplished, that it has been a work of years; first, it has been forshadowed as something desirable and possible, and after that it has been kept steadily in the mind until realised; the successes I have obtained have been won, more often than not by great exertion followed too often, by a period of mental prostration. Indeed, it is an axiom with me that no really good work is ever accomplished without being fairly dug out of oneself—the power of taking infinite pains has been defined by Carlyle as genius.

Those who explore for themselves and create new paths, very rarely meet with success all at once; surprises, and failure upon failure, usually dog their footsteps, and when at last success has been obtained as the reward of long continued and exhaustive effort, it is hard to see others step in and gather the harvest, and not only to do this, but also to endeavour to deprive you of the credit of having sown the seed and nursed the young tree until it began to shew fruit.

A self-exciting dynamo was foreshadowed by me as far back as 1859. When my late brother's multiplier was being constructed I told him what was wanted was a machine to do for dynamic electricity what his machine did for static electricity. I further added, such a machine will be made some day, and I hope I shall be permitted to be the one to do it; and I kept the matter steadily in my mind, experimenting as opportunity offered, until I had accomplished my object. It was only a fluke which prevented my machine being completed in time to bring it before section A of the British Association meeting of 1866, when Sir Charles Wheatstone was the President of the section. Now, both Wheatstone and Siemens, who

discovered the same principle afterwards, made their discoveries by accident with apparatus not constructed for the purpose of producing a self-exciting machine, whereas my machine was designed to produce a self-exciting dynamo after experiment had pointed out the way.

I am blamed sometimes for having kept away from scientific meetings, which I have practically done, I am sorry to say, now for a great many years, and I have been told I am regarded as a sort of myth, but the explanation is simple enough. The Postal Telegraph Department for me broke up a very prosperous and rapidly-growing manufacturing business which I had created by sheer hard work, and after I had done for the Department notably good service which fairly deserved recognition and consideration at the hands of the Postal Telegraph Department. The struggle I made at that period so completely broke down my health, that I was thought to be dying. I have slowly recovered, after being for 15 years more or less an invalid, and now I am happy to say I am fairly myself, and intend to fight for my own.

When I was looked up in September, 1885, in connection with the lawsuit of Brush *v.* Crompton (for more than one reason) I was loathe to move in the matter; but when once I had put my hand to the plough, I felt it lay to me to carry it through, for I was so circumstanced in relation to compound-winding, that if the electrical industry were to be delivered from having to pay a vexatious royalty to a powerful corporation who competed with them in the open market, it could only be done by my interposing, and I have recognised since then a time was approaching when I should probably consider I owed it to myself to burn my ships and force my detractors to fight me in the open; but I intended to wait, at all events, until the appeal in the suit of King, Brown & Co. *v.* the Anglo-Brush Corporation, had been disposed of, and therefore I should most probably have passed unheeded Prof. Perry's presidential address. Your article has forced my hand, and the first shot I regard as having been fired.

Looking upon the matter as a battle, I consider the small *clique* of aggressive, self-advertising and trading Professors, who are my detractors, have shown themselves now to be but indifferent strategists, and reading your article brought to my mind those words, "The Lord has delivered them into my hands," which were uttered on a memorable occasion by my ancestor, Oliver Cromwell.

Almost immediately after the case of Brush *v.* Crompton had been compromised, through the medium of the columns of the ELECTRICAL REVIEW, I fought single-handed. My friends would have held me back had they been able, regarding it as simply Quixotic for me to engage so powerful an antagonist, and the Anglo-Brush Corporation affected to despise me, and well they might, assisted as they were by able counsel, and such scientists as Sir William Thomson, Mr. Preece, Dr. Fleming, Prof. Perry, Silvanus Thompson, and others; but a new strategy was adopted, and the general engagement which has been fought *and won*, has been fought out, so far, on somewhat less unequal terms than it otherwise would have been.

I would ask the electrical industry to refer to the ELECTRICAL REVIEW, December 16th, 1867, p. 616. I there said: "There has been a feeling growing upon me now for some little time that there is a necessity for a new strategy. It is seldom sufficient to act only on the defensive; decisive victories are obtained more often than not by flank marches and attacking the base of operations. Messrs. King, Brown & Co., who have stood pluckily to their guns, adopted a new strategy, and made a flank march. I attacked the base of operations, I analysed the affidavits of the scientific experts, and I criticised that system which has grown up of late years in connection with scientific evidence, viz., the acceptance by men holding professorial chairs of general retainers, which compel them practically (however much they may dislike it) to become special pleaders, instead of independent witnesses of truth. And what was the result? All the affidavits sworn to in the case of Brush *v.* Crompton were abandoned, and an altogether new line of defence was adopted when the case came before the Court of Sessions, Edinburgh. It is only due to Sir W. Thomson that I should draw a distinction between his evidence and that of the other experts on the same side as himself. Sir William Thomson, unlike them, made an independent affidavit in the suit of Brush *v.* Crompton, which practically gave but little more than the support of his great name to his clients; and at the trial in Edinburgh, Lord Trayner, in his judgment, declared Thomson's evidence to have been on the plaintiff's side.

As the readers of this Journal will know, Lord Trayner's judgment was very complimentary to myself, but it must have been cold comfort to the experts on the side of the Anglo-Brush Corporation, among whom were Perry and Preece, and it could scarcely have been satisfactory to Prof. Silvanus Thompson to have his evidence described as "*neither reasonable nor* fair."

It is never wise to whistle before one is fairly out of the wood; but in the event of the judgment being sustained in the Court of Appeal, and we shall not have to wait an unduly long time for this, then I shall have every reason to congratulate myself, and I shall at the same time feel I have put the electrical industry, *as a whole*, under an obligation. With the support of Messrs. King, Brown & Co., who took upon themselves the responsibility of attacking the Anglo-Brush Corporation, and who bore the brunt of the battle (which in the earlier stages was carried on by this firm unassisted), there seems to be a very fair probability indeed that the industry is now relieved from having to pay any more royalties on the Brush patent; but whatever may be the result of the Appeal, the industry, I feel sure, has escaped from what would have been a much more serious matter, viz., a prolongation of the Brush patent being granted.

Had the compromise in which the previous suit of Brush *v.* Crompton ended been acquiesced in, and this certainly would have been the case but for my intervention, the Anglo-Brush Corporation, who command the services of the ablest counsel in the country, and who also have the tremendous scientific support which Thomson's name *alone* carries, assisted also as they would have been by other experts, whose official scientific status carries so much weight in the English Courts, there is every probability, in my opinion, that an application for an extension of the Brush patent would, under such circumstances, have been successful.

In my article which appeared in the ELECTRICAL REVIEW of December 9th, 1887, I said, in reference to what has been stated immediately above: "It requires no prescience to foresee, after the trade had acknowledged the claims asserted by the Brush Corporation by submitting to pay royalties, that the next step will be to apply for a prolongation of the patent on the ground that this *valuable* invention, due to the *genius* of Brush, has yielded no returns commensurate with the expenditure incurred in developing it. And who shall blame them for making such an application, seeing, in the circumstances I have mentioned, it would most probably be successful?"

The personal matters treated upon in this letter cannot end here; but, unless my hand be forced, I purpose waiting until after the appeal has been disposed of in the Courts of Edinburgh before proceeding further with what I intend to say.

S. Alfred Varley.

2, Hamilton Road, Highbury, N.

Transformer Efficiencies and Coal Bills.

I read with much interest your article of the 27th September on "The Efficiency of Transformers."

To-day I notice a letter from Mr. Hammond, in which he accounts for the high consumption of fuel at Brighton, by the use of heavy shafting and belting, and the old system of overhead wiring used.

It is hardly necessary to point out that none of these defects, especially the one last named, can so seriously affect the coal bill as to make it three times what it

ought to be; moreover, Mr. Wright, who was the managing director of the Brighton Company, stated at the Institution of Electrical Engineers, that these very boilers, engines, shafting and belting, when used to drive the old fashioned Brush series system, used in combination with storage batteries, consumed 17·6 lbs. of coal per electrical horse-power per hour, measured at the consumer's lamps, whereas when used to drive the alternate transformer system, the consumption was 18·6 lbs., and he then laid the blame on the low efficiency of the transformers during hours of little or no useful load.

Your article has thrown a very clear light on this subject, and I propose to show that if your calculations are carried out carefully for every month in the year, the total efficiency throughout the year will be considerably lower than stated in the article.

Having very complete data at my command, which shows, among other things: 1st. The proportion which the maximum load on the station bears to the total number of lamps attached to it. 2nd. The average number of hours which each lamp burns during the year, and 3rd. A set of curves showing the variation of daily load throughout every day in the year, I have been able to compile a table based on the efficiency of the transformer referred to by you in your article. This, I understand, was a 1,500 watt transformer. In other words, equal to supplying a maximum load of 45 33-watt or 10-candle lamps, and therefore a fair specimen of the transformer which would generally be employed in a medium-sized London house.

My data show that throughout the month of December the mean load of such a transformer would only reach 792 watts, or 53 per cent. of its full load for 30 hours in the month. That it would be under 400 watts, or 27 per cent. of its full load, for 190 hours, and the remainder of the output would be at a lower efficiency than 27 per cent.

The efficiency, therefore, of this transformer apart from all losses in the leads, whether in the primary conductors to the house, or in the secondary wiring within the house, will only be 69 per cent. for the best month in the year.

Finding that this was so, I carefully went through all the other months, with the result that I was able to compile the following table, which can be easily verified by those who care to devote as much attention to it as this subject deserves :—

	Comparative amount of output.	Efficiency of transformer.
August	1	26·5
September	1·2	39·0
October	2·6	42·0
November	4·44	57·0
December	6·67	69·0
January	5·5	64·0
February	4·3	57·0
March	3·4	54·0
April	2·6	42·0
May	1·75	40·0
June	1·5	37·0
July	1·02	27·0
Mean efficiency ...		0·53

Now as to the generating plant :—

Up to the present date, at any rate, as none of the alternating current systems have been able to subdivide their plant and work their engines and dynamos parallel, each district has had to have its own dynamo, and as a consequence, these dynamos and engines driving them have been certainly not loaded so regularly, and consequently not been able to work so efficiently as engines and dynamos generating current for the low tension systems.

In the case of these latter, however, it is found that such is the bad influence of partial loading, that even under the best management and most carefully subdivided system of plant, it is found from data which I have collected from America and from the Continent as well as in England, that during the month of December the best results obtained when calculated from the *actual coal bill* of the month, show a consumption of coal at least 25 per cent. in excess of the data obtained in full power trials, and in the month of July this difference reaches nearly 60 per cent.

I need hardly say that the main cause of this low efficiency during July is the quantity of coal wasted in getting up steam and heating up the boilers, flues, &c., for comparatively short runs. It appears, therefore, that although the efficiency of the generating plant, *i.e.*, the electrical horse-power of the terminals divided by the indicated horse-power in the engine cylinders, may be as high as 72 per cent. on full power runs, yet if the same efficiency be tested by the coal bill over the whole year, it is probably reduced to some point between 50 and 60 per cent.

If we compound the two efficiences as is done in your article, we get about 29 per cent. as a total efficiency of the whole system exclusive of loss in the conductors.

No doubt these figures will be severely criticised by some of those who are so blindly advocating the alternating transformer system, but I will ask my critics when replying to this letter, to explain how they would apportion the various losses to account for the Brighton figures of 18·6 lbs. of coal per electric horse-power per hour.

If my 29 per cent. be accepted, it still makes the Brighton engines use 5½ lbs. per indicated horse, and I think that Messrs. Fowlers will have something to say if any attempt is made to show that these engines use anything like this figure.

At some future date I propose to show you that with the direct supply systems, both with and without batteries, it is quite easy to produce an electrical horse-power, with a consumption of 6 lbs. of coal calculated from the monthly coal bills.

R. E. Crompton.

October 16th, 1889.

On Strikes.

Labour *v.* Capital is a question in which I take a great interest, and which I strive to judge dispassionately. As it seems to me you have written your article in a spirit of opposition to the labourer, with your permission I will advocate his cause.

You say, "The horny-handed sons of toil are apparently in a perfectly happy frame of mind," &c., till John Burns & Co. appear on the scene as Tempters in the 19th Century Paradise. In the neighbourhood of the Docks there is a scarcity of clothes and capital amongst the inhabitants which has some resemblance with the state of affairs in the Garden of Eden, but in other respects the difference is considerable. The reason Burns commences his agitation among the labourers, and not the Bishops, is because the former are badly paid and discontented and the latter are not. The public, if not you, are aware of this fact, and are also conscious that, till now, capital has been all powerful against rough labour. It is this that makes some people look on the men more as martyrs than combatants.

You say the men have a perfect right to refuse to work for less than they think proper. Why, then, call them "poor misguided creatures," "demented beings," &c.? Demented or not, $\frac{8}{10}$ths, or more, of the population of England are very much like them. It is very curious that you should see demention in the men just when most people see more of it in the masters. I know nothing of the merits of the Silvertown strike except what is in the REVIEW, but I am sure the time has gone by for high-handed action like that of Mr. Gray to be of avail. Public sympathy is now a very powerful factor. Why you should speak about the *evil* effects of Mr. Burns's teaching in connection with the dockyard strike I cannot imagine. The effect was that the men got what they were justly entitled to. You seem to regard all strikers as foolish and their leaders as criminal. We differ in this. I regard all idleness as a state to be deplored whether it is temporary, like during the strikes, or lifelong as in the case of so many rich people in England. I regard, however, with favour everything which tends in the long run to make the division of gains between capital and labour more equal. The successful attempt of the labourers

to organise had, in my opinion, this tendency. Capital *v.* Labour is a war in which labour is attacking a fortress. If the attack be made without proper plan or system it will be worse than useless. Both sides will lose, but the attacking party most. Now that Trades Unions are so well managed strikes of a hopeless character will seldom occur. There can be only one end to the struggle : "The poor demented creatures" will, in time, become capitalists and labourers combined. Then those who have a stake in the country will be nearly the whole population, and not a small proportion who contrive to make the others work for them.

As I read in Continental papers how peacefully the great strike had been conducted in England, I felt proud of my native country and confident in her happy destiny. I shall not despond, even if more strikes occur.

L. Miller.

Zurich, Switzerland, *October* 16*th*, 1889.

Lighting Public Vehicles.

In reading an article in this week's issue of your paper, headed, "The Lighting of Public Vehicles," the thought suggested itself to me that I ought to say a word on the subject, and inform you that I was greatly interested a few nights ago, while travelling on a 'bus from Putney Bridge to King's Road, Chelsea, with some little information obtained from the 'bus conductor relative to the lighting of the said 'bus with an electric lamp. The conductor, I must say, was exceedingly polite, and explained to me that the lamp was worked from a battery on the top of the 'bus, &c. The light was beautifully brilliant, and it was quite a comfort, both to myself and all other passengers, many of whom were reading. The lamp was situated under the driver's seat.

H. Luttrell-Elward.

October 19*th*, 1889.

Queries.

In your No. of the ELECTRICAL REVIEW for September 6th, page 280, in reply to a student's enquiry, the amount of condenser capacity required as a *shunt* to the neutral or non-polarised Stroh's relay is given to be about 10 mf. for an aerial line of 800 miles of iron wire. It is believed, however, that this shunting of the non-polarised relay does not materially aid in bridging over the break of signal on the neutral relay, as the charge taken up by the *shunt condensers* and consequently the discharge is not sufficient to maintain the high potential, 15 to 20 milliampères, required for the non-polarised relay during the periods of reversal when the potential of the line falls to zero ; though from papers on condensers, if I remember rightly, by Sir William Thomson and Mascart, one would expect otherwise.

For the particular case, what would be the potential of discharge approximately from the shunt of 10 mf. ? In this respect please say what is the experience on the Continent ?

2. In the balancing circuit of a differential Dx. or Qdx. on the particular line, would a number of condensers of low capacity, interspersed in the circuit, secure more stability than the sum of them as a permanent set applied at the beginning of the circuit ?

3. What arrangement other than the condenser one operates to do away with the sparking in the electro-magnetic transmitters, which is considerable, when a large battery of 250 bichromate cells is employed ?

4. How would it be best to apply Mr. G. K. Winter's electro-magnetic induction arrangement, described in the TELEGRAPHIC JOURNAL, Vol. II., No. 39, pages 303–305 for the 15th September, 1874, in conjunction with a Dx. or Qdx. system on an aerial line ?

5. Beyond aiding in the formation of a signal, would the above allow of the system being worked with less current than ordinarily employed ?

6. What difference in action or construction is there between an "alternating transformer" and a "battery transformer ?" How could they be applied to the receiving instrument (Morse), and with what advantage ?

7. When two transformers are joined parallel, how can a nearly constant secondary pressure be achieved ?

A thorough paper by some of your many readers on quadruplex working, with its latest improvements, would be very welcome to not a few.

A Student.

Allahabad, *September* 28*th*, 1889.

[(1.) Our correspondent should be more careful to read correctly what appears in the REVIEW ; there was nothing whatever said in our issue of the 6th with reference to the "condenser capacity required as a shunt *to the neutral or non-polarised Stroh's relay* (we have never heard of this relay)." The capacity of 10 microfarads is that required to balance the static discharge from the line, and it is the same as that which would be required for ordinary duplex working. Condensers are not used in this country on quadruplex circuits for shunting the non-polarised relays, as it has long ago been found that no benefit whatever is derived from their employment. Only a few quadruplex circuits are in use on the Continent, and the system employed is the same as that in this country. (2.) The condenser in a quadruplex or duplex system is used to counteract the static discharge from the line ; to "intersperse the capacity in the circuit" would have exactly the opposite effect to that required ; it would be like trying to obtain a balance on a Wheatstone bridge by placing the balancing resistance in the circuit of the resistance being measured instead of in the opposite arm of the bridge. (3.) A condenser will not do away with the spark at the contact points of the transmitter, as this spark is not an "extra current" spark, but is of the nature of the voltaic arc ; the only cure is to place a resistance direct in the battery circuit. (4.) The electro-magnetic shunt should be used in the place of, and in the same position as, the shunted condenser ; it would not be such a satisfactory arrangement, however, as the shunted condenser. (5.) No. (6.) (7.) We do not clearly understand what you mean by these questions ; you do not appear to know what a transformer is.—EDS. ELEC. REV.]

I wish to ask you for some information on static discharges.

1. If a plate of glass be connected to earth would it not become zero potential ? that is, if the glass had been charged, would not the act of connecting the charged glass to earth have dissipated the charge ?

2. If such is the case, then if a second plate of glass be placed facing the first, being itself connected with a thunder cloud, would the cloud discharge ?

3. If the second plate were of metal ?

4. Is not the discharge of a cloud into the earth exactly analogous to the discharge of a very small body at high potential into a very large body of zero potential, the tension between the two having been increased by condenser action ?

J. M. B.

Pittsburg, *October* 8*th*, 1889.

[Our correspondent's queries are not at all clear, but we will endeavour to reply to them as far as possible. (1.) The plate would become zero in potential provided the *whole surface* were connected to earth by a conductor, *i.e.*, it would not be sufficient to touch one point of the surface by a conductor ; if this were done the plate would be only discharged at this particular point. (2.) The mere use of the second glass plate would produce no effect ; whatever took place would be due to the conductor between the cloud and the glass plate and not to the latter. (3.) The metal plate would have the same effect as bringing the cloud down to the position occupied by the plate. (4.) Yes.—EDS. ELEC. REV.]